GE Healthcare

Corometrics™ 250cx Series Monitor

Service Manual

Corometrics 250cx Series Monitor English
2036947-001 Revision J
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Warranty

This product is sold by GE Healthcare with a GE repair warranty period of 12-month to cover labor and parts* (except for the expendable parts like fuses or batteries which have a 30-day warranty) under the terms and conditions set forth in the GE Healthcare Warranty Statement presented to the customer at the point of sale.

* The warranty time may vary in some regions. Refer to the warranty information provided at the point of sale.

ПРЕДУПРЕЖДЕНИЕ

Това упътване за работа е налично само на английски език.

(BG)

- Ако доставчикът на услугата на клиента изиска друг език, задължение на клиента е да осигури превод.
- Не използвайте оборудването, преди да сте се консултирали и разбрали упътването за работа.
- Неспазването на това предупреждение може да доведе до нараняване на доставчика на услугата, оператора или пациента в резултат на токов удар, механична или друга опасност.

警告

本维修手册仅提供英文版本。

(ZH-CN)

- 如果客户的维修服务人员需要非英文版本，则客户需自行提供翻译服务。
- 未详细阅读和完全理解本维修手册之前，不得进行维修。
- 忽略本警告可能对维修服务人员、操作人员或患者造成电击、机械伤害或其他形式的伤害。

警告

本服務手冊僅提供英文版本。

(ZH-HK)

- 倘若客戶的服務供應商需要英文以外之服務手冊，客戶有責任提供翻譯服務。
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警告

本維修手冊僅有英文版。

(ZH-TW)

- 若客戶的維修廠商需要英文版以外的語言，應由客戶自行提供翻譯服務。
- 請勿試圖維修本設備，除非 您已查閱並瞭解本維修手冊。
- 若未留意本警告，可能導致維修廠商、操作員或病患因觸電、機械或其他危險而受傷。

UPOZORENJE

Ovaj servisni priručnik dostupan je na engleskom jeziku.

(HR)

- Ako davatelj usluge klijenta treba neki drugi jezik, klijent je dužan osigurati prijevod.
- Ne pokušavajte servisirati opremu ako niste u potpunosti pročitali i razumjeli ovaj servisni priručnik.
- Zanemarite li ovo upozorenje, može doći do ozljede davatelja usluge, operatera ili pacijenta uslijed strujnog udara, mehaničkih ili drugih rizika.

VÝSTRAHA

Tento provozní návod existuje pouze v anglickém jazyce.

(CS)

- V případě, že externí služba zákazníkům potřebuje návod v jiném jazyce, je zajištění překladu do odpovídajícího jazyka úkolem zákazníka.
- Nesnažte se o údržbu tohoto zařízení, aniž byste si přečetli tento provozní návod a pochopili jeho obsah.
- V případě nedodržování této výstrahy může dojít k poranění pracovníka prodejního servisu, obslužného personálu nebo pacientů vlivem elektrického proudu, respektive vlivem mechanických či jiných rizik.

ADVARSEL

Denne servicemanual findes kun på engelsk.

(DA)

- Hvis en kundes tekniker har brug for et andet sprog end engelsk, er det kundens ansvar at sørge for oversættelse.
- Forsøg ikke at servicere udstyret uden at læse og forstå denne servicemanual.
- Manglende overholdelse af denne advarsel kan medføre skade på grund af elektrisk stød, mekanisk eller anden fare for teknikeren, operatøren eller patienten.

WAARSCHUWING

Deze onderhoudshandleiding is enkel in het Engels verkrijgbaar.

(NL)

- Als het onderhoudspersoneel een andere taal vereist, dan is de klant verantwoordelijk voor de vertaling ervan.
- Probeer de apparatuur niet te onderhouden alvorens deze onderhoudshandleiding werd geraadpleegd en begrepen is.
- Indien deze waarschuwing niet wordt opgevolgd, zou het onderhoudspersoneel, de operator of een patiënt gewond kunnen raken als gevolg van een elektrische schok, mechanische of andere gevaren.

WARNING:

This service manual is available in English only.

(EN)

- If a customer's service provider requires a language other than English, it is the customer's responsibility to provide translation services.
- Do not attempt to service the equipment unless this service manual has been consulted and is understood.
- Failure to heed this warning may result in injury to the service provider, operator, or patient from electric shock, mechanical hazards, or other hazards.

HOIATUS

See teenindusjuhend on saadaval ainult inglise keeles

(ET)

- Kui klienditeeninduse osutaja nõuab juhendit inglise keelest erinevas keeles, vastutab klient tõlketeenuse osutamise eest.
- Ärge üritage seadmeid teenindada enne eelnevalt käesoleva teenindusjuhendiga tutvumist ja sellest aru saamist.
- Käesoleva hoiatuse eiramine võib põhjustada teenuseosutaja, operaatori või patsiendi vigastamist elektrilöögi, mehaanilise või muu ohu tagajärjel.

VAROITUS

Tämä huolto-ohje on saatavilla vain englanniksi.

(FI)

- Jos asiakkaan huoltohenkilöstö vaatii muuta kuin englanninkielistä materiaalia, tarvittavan käännöksen hankkiminen on asiakkaan vastuulla.
- Älä yritä korjata laitteistoa ennen kuin olet varmasti lukenut ja ymmärtänyt tämän huolto-ohjeen.
- Mikäli tätä varoitusta ei noudateta, seurauksena voi olla huoltohenkilöstön, laitteiston käyttäjän tai potilaan vahingoittuminen sähköiskun, mekaanisen vian tai muun vaaratilanteen vuoksi.

ATTENTION

Ce manuel d'installation et de maintenance est disponible uniquement en anglais.

(FR)

- Si le technicien d'un client a besoin de ce manuel dans une langue autre que l'anglais, il incombe au client de le faire traduire.
- Ne pas tenter d'intervenir sur les équipements tant que ce manuel d'installation et de maintenance n'a pas été consulté et compris.
- Le non-respect de cet avertissement peut entraîner chez le technicien, l'opérateur ou le patient des blessures dues à des dangers électriques, mécaniques ou autres.

WARNUNG

Diese Serviceanleitung existiert nur in englischer Sprache.

(DE)

- Falls ein fremder Kundendienst eine andere Sprache benötigt, ist es Aufgabe des Kunden für eine entsprechende Übersetzung zu sorgen.
- Versuchen Sie nicht diese Anlage zu warten, ohne diese Serviceanleitung gelesen und verstanden zu haben.
- Wird diese Warnung nicht beachtet, so kann es zu Verletzungen des Kundendiensttechnikers, des Bedieners oder des Patienten durch Stromschläge, mechanische oder sonstige Gefahren kommen.

ΠΡΟΕΙΔΟΠΟΙΗΣΗ

Το παρόν εγχειρίδιο σέρβις διατίθεται μόνο στα αγγλικά.

(EL)

- Εάν ο τεχνικός σέρβις ενός πελάτη απαιτεί το παρόν εγχειρίδιο σε γλώσσα εκτός των αγγλικών, αποτελεί ευθύνη του πελάτη να παρέχει τις υπηρεσίες μετάφρασης.
- Μην επιχειρήσετε την εκτέλεση εργασιών σέρβις στον εξοπλισμό αν δεν έχετε συμβουλευτεί και κατανοήσει το παρόν εγχειρίδιο σέρβις.
- Αν δεν προσέξετε την προειδοποίηση αυτή, ενδέχεται να προκληθεί τραυματισμός στον τεχνικό σέρβις, στο χειριστή ή στον ασθενή από ηλεκτροπληξία, μηχανικούς ή άλλους κινδύνους.

FIGYELMEZTETÉS

Ezen karbantartási kézikönyv kizárólag angol nyelven érhető el.

(HU)

- Ha a vevő szolgáltatója angoltól eltérő nyelvre tart igényt, akkor a vevő felelőssége a fordítás elkészíttetése.
- Ne próbálja elkezdeni használni a berendezést, amíg a karbantartási kézikönyvben leírtakat nem értelmezték.
- Ezen figyelmeztetés figyelmen kívül hagyása a szolgáltató, működtető vagy a beteg áramütés, mechanikai vagy egyéb veszélyhelyzet miatti sérülését eredményezheti.

AÐVÖRUN

Þessi þjónustuhandbók er aðeins fáanleg á ensku.

(IS)

- Ef að þjónustuveitandi viðskiptamanns þarfnast annas tungumáls en ensku, er það skylda viðskiptamanns að skaffa tungumálaþjónustu.
- Reynið ekki að afgreiða tækið nema að þessi þjónustuhandbók hefur verið skoðuð og skilin.
- Brot á sinna þessari aðvörun getur leitt til meiðsla á þjónustuveitanda, stjórnanda eða sjúklings frá raflosti, vélrænu eða öðrum áhættum.

AVVERTENZA

Il presente manuale di manutenzione è disponibile soltanto in lingua inglese.

(IT)

- Se un addetto alla manutenzione richiede il manuale in una lingua diversa, il cliente è tenuto a provvedere direttamente alla traduzione.
- Procedere alla manutenzione dell'apparecchiatura solo dopo aver consultato il presente manuale ed averne compreso il contenuto.
- Il mancato rispetto della presente avvertenza potrebbe causare lesioni all'addetto alla manutenzione, all'operatore o ai pazienti provocate da scosse elettriche, urti meccanici o altri rischi.

警告

このサービスマニュアルには英語版しかありません。

(JA)

- **サービスを担当される業者が英語以外の言語を要求される場合、翻訳作業はその業者の責任で行うものとさせていただきます。**
- **このサービスマニュアルを熟読し理解せずに、装置のサービスを行わないでください。**
- **この警告に従わない場合、サービスを担当される方、操作員あるいは患者 さんが、感電や機械的又はその他の危険により負傷する可能性があります。**

경고

본 서비스 매뉴얼은 영어로만 이용하실 수 있습니다.

(KO)

- 고객의 서비스 제공자가 영어 이외의 언어를 요구할 경우, 번역 서비스를 제공하는 것은 고객의 책임입니다.
- 본 서비스 매뉴얼을 참조하여 숙지하지 않은 이상 해당 장비를 수리하려고 시도하지 마십시오.
- 본 경고 사항에 유의하지 않으면 전기 쇼크, 기계적 위험, 또는 기타 위험으로 인해 서비스 제공자, 사용자 또는 환자에게 부상을 입힐 수 있습니다.

BRĪDINĀJUMS

Šī apkopes rokasgrāmata ir pieejama tikai angļu valodā.

(LV)

- Ja klienta apkopes sniedzējam nepieciešama informācija citā valodā, klienta pienākums ir nodrošināt tulkojumu.
- Neveiciet aprīkojuma apkopi bez apkopes rokasgrāmatas izlasīšanas un saprašanas.
- Šī brīdinājuma neievērošanas rezultātā var rasties elektriskās strāvas trieciena, mehānisku vai citu faktoru izraisītu traumu risks apkopes sniedzējam, operatoram vai pacientam.

ĮSPĖJIMAS

Šis eksploatavimo vadovas yra tik anglų kalba.

(LT)

- Jei kliento paslaugų tiekėjas reikalauja vadovo kita kalba – ne anglų, suteikti vertimo paslaugas privalo klientas.
- Nemėginkite atlikti įrangos techninės priežiūros, jei neperskaitėte ar nesupratote šio eksploatavimo vadovo.
- Jei nepaisysite šio įspėjimo, galimi paslaugų tiekėjo, operatoriaus ar paciento sužalojimai dėl elektros šoko, mechaninių ar kitų pavojų.

ADVARSEL

Denne servicehåndboken finnes bare på engelsk.

(NO)

- Hvis kundens serviceleverandør har bruk for et annet språk, er det kundens ansvar å sørge for oversettelse.
- Ikke forsøk å reparere utstyret uten at denne servicehåndboken er lest og forstått.
- Manglende hensyn til denne advarselen kan føre til at serviceleverandøren, operatøren eller pasienten skades på grunn av elektrisk støt, mekaniske eller andre farer.

OSTRZEŻENIE

Niniejszy podręcznik serwisowy dostępny jest jedynie w języku angielskim.

(PL)

- Jeśli serwisant klienta wymaga języka innego niż angielski, zapewnienie usługi tłumaczenia jest obowiązkiem klienta.
- Nie próbować serwisować urządzenia bez zapoznania się z niniejszym podręcznikiem serwisowym i zrozumienia go.
- Niezastosowanie się do tego ostrzeżenia może doprowadzić do obrażeń serwisanta, operatora lub pacjenta w wyniku porażenia prądem elektrycznym, zagrożenia mechanicznego bądź innego.

AVISO

Este manual de assistência técnica encontra-se disponível unicamente em inglês.

(PT-BR)

- Se outro serviço de assistência técnica solicitar a tradução deste manual, caberá ao cliente fornecer os serviços de tradução.
- Não tente reparar o equipamento sem ter consultado e compreendido este manual de assistência técnica.
- A não observância deste aviso pode ocasionar ferimentos no técnico, operador ou paciente decorrentes de choques elétricos, mecânicos ou outros.

ATENÇÃO

Este manual de assistência técnica só se encontra disponível em inglês.

(PT-PT)

- Se qualquer outro serviço de assistência técnica solicitar este manual noutro idioma, é da responsabilidade do cliente fornecer os serviços de tradução.
- Não tente reparar o equipamento sem ter consultado e compreendido este manual de assistência técnica.
- O não cumprimento deste aviso pode colocar em perigo a segurança do técnico, do operador ou do paciente devido a choques eléctricos, mecânicos ou outros.

ATENȚIE

Acest manual de service este disponibil doar în limba engleză.

(RO)

- Dacă un furnizor de servicii pentru clienți necesită o altă limbă decât cea engleză, este de datoria clientului să furnizeze o traducere.
- Nu încercați să reparați echipamentul decât ulterior consultării şi înțelegerii acestui manual de service.
- Ignorarea acestui avertisment ar putea duce la rănirea depanatorului, operatorului sau pacientului în urma pericolelor de electrocutare, mecanice sau de altă natură.

ОСТОРОЖНО!

Данное руководство по техническому обслуживанию представлено только на английском языке.

(RU)

- Если сервисному персоналу клиента необходимо руководство не на английском, а на каком-то другом языке, клиенту следует самостоятельно обеспечить перевод.
- Перед техническим обслуживанием оборудования обязательно обратитесь к данному руководству и поймите изложенные в нем сведения.
- Несоблюдение требований данного предупреждения может привести к тому, что специалист по техобслуживанию, оператор или пациент получит удар электрическим током, механическую травму или другое повреждение.

UPOZORENJE

Ovo servisno uputstvo je dostupno samo na engleskom jeziku.

(SR)

- Ako klijentov serviser zahteva neki drugi jezik, klijent je dužan da obezbedi prevodilačke usluge.
- Ne pokušavajte da opravite uređaj ako niste pročitali i razumeli ovo servisno uputstvo.
- Zanemarivanje ovog upozorenja može dovesti do povređivanja servisera, rukovaoca ili pacijenta usled strujnog udara ili mehaničkih i drugih opasnosti.

UPOZORNENIE

Tento návod na obsluhu je k dispozícii len v angličtine.

(SK)

- Ak zákazníkov poskytovateľ služieb vyžaduje iný jazyk ako angličtinu, poskytnutie prekladateľských služieb je zodpovednosťou zákazníka.
- Nepokúšajte sa o obsluhu zariadenia, kým si neprečítate návod na obluhu a neporozumiete mu.
- Zanedbanie tohto upozornenia môže spôsobiť zranenie poskytovateľa služieb, obsluhujúcej osoby alebo pacienta elektrickým prúdom, mechanické alebo iné ohrozenie.

ATENCION

Este manual de servicio sólo existe en inglés.

(ES)

- Si el encargado de mantenimiento de un cliente necesita un idioma que no sea el inglés, el cliente deberá encargarse de la traducción del manual.
- No se deberá dar servicio técnico al equipo, sin haber consultado y comprendido este manual de servicio.
- La no observancia del presente aviso puede dar lugar a que el proveedor de servicios, el operador o el paciente sufran lesiones provocadas por causas eléctricas, mecánicas o de otra naturaleza.

VARNING

Den här servicehandboken finns bara tillgänglig på engelska.

(SV)

- Om en kunds servicetekniker har behov av ett annat språk än engelska, ansvarar kunden för att tillhandahålla översättningstjänster.
- Försök inte utföra service på utrustningen om du inte har läst och förstår den här servicehandboken.
- Om du inte tar hänsyn till den här varningen kan det resultera i skador på serviceteknikern, operatören eller patienten till följd av elektriska stötar, mekaniska faror eller andra faror.

OPOZORILO

Ta servisni priročnik je na voljo samo v angleškem jeziku.·

(SL)

- Če ponudnik storitve stranke potrebuje priročnik v drugem jeziku, mora stranka zagotoviti prevod.·
- Ne poskušajte servisirati opreme, če tega priročnika niste v celoti prebrali in razumeli.·
- Če tega opozorila ne upoštevate, se lahko zaradi električnega udara, mehanskih ali drugih nevarnosti poškoduje ponudnik storitev, operater ali bolnik.

DİKKAT

Bu servis kılavuzunun sadece ingilizcesi mevcuttur.

(TR)

- Eğer müşteri teknisyeni bu kılavuzu ingilizce dışında bir başka lisandan talep ederse, bunu tercüme ettirmek müşteriye düşer.
- Servis kılavuzunu okuyup anlamadan ekipmanlara müdahale etmeyiniz.
- Bu uyarıya uyulmaması, elektrik, mekanik veya diğer tehlikelerden dolayı teknisyen, operatör veya hastanın yaralanmasına yol açabilir.

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Compliance

A GE brand Corometrics™ 250cx Series Monitor bears CE mark CE-0459 indicating its conformity with the provisions of the Council Directive 93/42/EEC concerning medical devices and fulfills the essential requirements of Annex I of this directive.

The device is manufactured in India; the CE mark is applied under the authority of Notified Body GMED (0459).

The country of manufacture and appropriate Notified Body can be found on the equipment labeling.

The product complies with the requirements of standard EN 60601-1-2 "Electromagnetic Compatibility—Medical Electrical Equipment" and standard EN 60601-1 "General Requirements for Safety."

Components of the Certified Systems

The IEC electromagnetic compatibility (EN) standards require individual equipment (components and accessories) to be configured as a system for evaluation. For systems that include a number of different equipment that perform a number of functions, one of each type of equipment shall be included in the evaluation.

The equipment listed below is representative of all possible combinations. For individual equipment certification, refer to the appropriate declarations of conformity.

Component Description

- 250cx Series Maternal/Fetal Monitor
- Model 146 Fetal Acoustic Stimulator
- Intrauterine Pressure Transducer
- FECG Cable/Legplate
- Ultrasound Transducers (x2)
- Blood Pressure Hose and Cuff
- $MSpO_2$ Interconnect Cable and Sensor
- MECG Cable
- FECG/MECG Adapter Cable
- Remote Event Marker
- RS-232C Interconnect Cables (x3)
- Central Nurses Station Interconnect Cable
- Model 2116B Keyboard and Interconnect Cable
- Model 1563AAO Telemetry Cable
- Exergen® TAT-5000™
- External 15" display

Exceptions

None

Monitor System EMC: Immunity Performance

Be aware that adding accessories or components, or modifying the medical device or system may degrade the EMI performance. Consult with qualified personnel regarding changes to the system configuration.

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About this Manual

Scope and Intended Users

This service manual describes the installation, maintenance, checkout, calibration and repair of the Corometrics™ 250cx Series monitor. The intended users for this service manual are biomedical engineering service providers of the hospitals and GE service personnel.

Conventions

	WARNING: A WARNING statement is used when the possibility of injury to the patient or the operator exists.
	CAUTION: A CAUTION statement is used when the possibility of damage to the equipment exists.
	SENSITIVE TO ELECTROSTATIC DISCHARGE CAUTION An electrostatic discharge (ESD) Susceptibility symbol is displayed to alert service personnel that the part(s) are sensitive to electrostatic discharge and that static control procedures must be used to prevent damage to the equipment.

User Responsibility

This Product will perform in conformity with the description thereof contained in this manual and accompanying labels and/or inserts, when assembled, operated, maintained and repaired in accordance with the instructions provided. This Product must be checked periodically. A defective Product should not be used. Parts that are broken, missing, plainly worn, distorted or contaminated should be replaced immediately. Should such repair or replacement become necessary, GE Healthcare recommends that a telephone or written request for service advice be made to the nearest GE Healthcare Regional Service Center. This Product or any of its parts should not be repaired other than in accordance with written instructions provided by GE Healthcare and by GE Healthcare trained personnel. The Product must not be altered without GE Healthcare's prior written approval. The user of this Product shall have the sole responsibility for any malfunction that results from improper use, faulty maintenance, improper repair, damage or alteration by anyone other than GE Healthcare.

This Product is intended for use by clinical professionals who are expected to know the medical procedures, practices, and terminology required to monitor obstetrical patients. This manual documents all possible parameters available in the Corometrics™ 250cx Series monitor. It is the responsibility of each hospital to ensure that the Labor and Delivery staff is trained in all aspects of the selected model. The Corometrics™ 250cx Series monitor is designed to assist the perinatal staff by providing information regarding the clinical status of the mother and fetus during labor. The monitor does not replace observation and evaluation of the mother and fetus at regular intervals, by a qualified care provider, who will make diagnoses and decide on treatments or

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interventions. Visual assessment of the monitor display and strip chart must be combined with knowledge of patient history and risk factors to properly care for the mother and fetus.

WARNING:
This device shall not be repaired other than in accordance with written instructions provided by GE Healthcare and by GE Healthcare trained personnel.

CAUTION:
Untied States federal law restricts this device to sale by or on the order of a licensed medical practitioner.

References

The following table lists other manuals pertaining to the Corometrics™ 250cx Series monitor service manual:

References	Orderable Part Number
Corometrics™ 250cx Series Monitor Operator's Manual (English)	2036946-001
Corometrics™ Model 340 Service Manual	2006920-001
Mini Telemetry System Service Manual	2049821-001
Fluke® PS320 Fetal Simulator User's Manual	Visit www.flukebiomedical.com
Maternal/Fetal Monitoring Clinical Application Operator's Manual	15457AA
Corometrics™ Fetal Acoustic Stimulator Operator's Manual	1168AA

Definitions of Terms

Term	Definition
BPM	Beat Per Minute
ECG	Electrocardiogram
ESD	Electro Static Discharge
FECG	Fetal Electrocardiogram
FHR	Fetal Heart Rate
FAST	Fetal Acoustic Stimulation Test
FMD	Fetal Movement Detection
HBC	Heart Beat Coincidence
INOP	Inoperable
IUPC	Intra-Uterine Pressure Catheter
LCD	Liquid Crystal Display
MECG	Maternal Electrocardiogram
NIBP	Non-Invasive Blood Pressure
REM	Remote Event Marker
SpO2	Pulse Oximeter Oxygen Saturation
TOCO	Non-invasive method of measuring uterine activity

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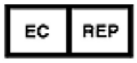
Term	Definition
UA	Uterine Activity
US	Ultrasound

Symbols

This section identifies the symbols that are displayed on the Corometrics™ 250cx Series monitor:

Equipment Symbols	
	TYPE BF EQUIPMENT: Type BF equipment is suitable for intentional external and internal application to the patient, excluding direct cardiac application. Type BF equipment has an F-type applied part.
	DEFIBRILLATOR-PROOF TYPE BF EQUIPMENT: Type BF equipment is suitable for intentional external and internal application to the patient, excluding direct cardiac application. Type BF equipment is type B equipment with an F-type isolated (floating) part. The paddles indicate the equipment is defibrillator proof.
	TYPE CF EQUIPMENT: Type CF equipment is suitable for intentional external and internal application to the patient, including direct cardiac application. Type CF equipment has an F-type applied part.
	DEFIBRILLATOR-PROOF TYPE CF EQUIPMENT: Type CF equipment is suitable for intentional external and internal application to the patient including direct cardiac application. Type CF equipment is F-type applied part that provides a higher degree of protection against electric shock than that provided by Type BF applied parts.
	Consult accompanying documents.
	Alternating Current (AC)
	Ground Equalization Potential Post
	POWER OFF: disconnection from the mains
	POWER ON: connection to the mains
	European Union Representative
	Catalog Number
	Serial Number
	Manufacturer

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Equipment Symbols	
	practitioner.
	disposed as unsorted municipal waste and must be collected separately. Please contact the

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Important Safety Information

The service information is important for the safety of both the patient and operator and also serves to enhance equipment reliability.

WARNING:
Before servicing the Corometrics™ 250cx Series monitor, read through this entire manual. As with all medical equipment, attempting to use this device without a thorough understanding of its operation may result in patient or user injury. This device should be serviced only by authorized service personnel. Additional precautions specific to certain procedures are found in the text of this manual.

The information contained in this service manual pertains only to those models of products which are marketed by GE Healthcare as of the effective date of this manual or the latest revision thereof. This service manual was prepared for exclusive use by GE Healthcare service personnel in light of their training and experience as well as the availability to them of parts, proper tools, and test equipment. Consequently, GE Healthcare provides this service manual to its customers purely as a business convenience and for the customer's general information only without warranty of the results with respect to any application of such information.

Furthermore, because of the wide variety of circumstances under which maintenance and repair activities may be performed and the unique nature of each individual's own experience, capacity, and qualifications, the fact that a customer has received such information from GE Healthcare does not imply in any way that GE Healthcare deems said individual to be qualified to perform any such maintenance or repair service. Moreover, it should not be assumed that every acceptable test and safety procedure or method, precaution, tool, equipment, or device is referred to within, or that abnormal or unusual circumstances may not warrant or suggest different or additional procedures or requirements. This manual is subject to periodic review, update, and revision. Customers are cautioned to obtain and consult the latest revision before undertaking any service of the equipment.

WARNING:
The user or service staff should dispose of all the waste properly as per federal, state, and local waste disposal regulations. Improper disposal could result in personal injury and environmental impact

Do not use malfunctioning equipment. If the system is under warranty, contact GE technical support at the number on the back of the manual PRIOR to performing any repairs on the system.

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Warnings, Cautions and Notes

WARNING:
ACCIDENTAL SPILLS: In the event that fluids are accidentally spilled on the monitor, take the monitor out of operation and inspect for damage.

WARNING:
APPLICATION: This monitor is not designed for direct cardiac connection.

WARNING:
CONDUCTIVE CONNECTIONS: Avoid making any conductive connections to applied parts (patient connection) which are likely to degrade safety.

WARNING:
CONDUCTIVE PARTS: Ensure that the conductive parts of the lead electrodes and associated connectors do not contact other conductive parts including earth.

WARNING:
CONNECTIONS: The correct way to connect a patient to the monitor is to plug the electrode leads into the patient cable which in turn connects to the monitor. The monitor is connected to the wall socket by the power cord. Do not plug the electrode leads into the power cord, a wall socket, or an extension cord.

WARNING:
DEFIBRILLATION: During defibrillation, all personnel must avoid contact with the patient and monitor to avoid a dangerous shock hazard. In addition, proper placement of the paddles in relation to the electrodes is required to minimize harm to the patient.

WARNING:
DEFIBRILLATION PROTECTION: When used with the GE-recommended accessories, the monitor is protected against the effects of defibrillator discharge. If monitoring is disrupted by the defibrillation, the monitor will recover.

WARNING:
ELECTRICAL SHOCK: To avoid electrical shock hazard, do not operate the monitor with the top cover removed.

WARNING:
ELECTROMAGNETIC INTERFERENCE: Strong electromagnetic fields may interfere with monitor operation. Interference prevents the clear reception of signals by the monitor. If the hospital is close to a strong transmitter such as TV, AM or FM radio, police or fire stations, a HAM radio operator, an airport, or cellular phone, their signals could be picked up as monitor signals. If you feel interference is affecting the monitor, contact your service representative to check the monitor in your environment. Refer to Electromagnetic Interference section for additional information.

WARNING:
ELECTROSURGERY: The monitor is not designed for use with high-frequency surgical devices. In addition, measurements may be affected in the presence of strong electromagnetic sources such as electrosurgery equipment.

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WARNING:
EXPLOSION HAZARD: Do not use this equipment in the presence of flammable anesthetics or inside an oxygen tent.

WARNING:
GROUNDING: To avoid electrical shock hazard to the patient or the operator, do not defeat the three-wire grounding feature of the power cord by means of adaptors, plug modifications, or other methods.

WARNING:
INOPERABLE MECG: The MECG trace is not visible during a LEADS OFF condition or an overload (saturation) of the frontend amplifier during differential input voltage of more than ±300mV.

WARNING:
INSTRUCTIONS: For continued and safe use of this equipment, it is necessary to follow all listed instructions. However, the instructions provided in this manual in no way supersede established medical procedures concerning patient care. The monitor does not replace observation and evaluation of the patient, at regular intervals, by a qualified care provider who will make diagnoses and decide on treatments and interventions

WARNING:
INTERFACING OTHER EQUIPMENT: Monitoring equipment must be interfaced with other types of medical equipment by qualified biomedical engineering personnel. Consult manufacturers' specifications to maintain safe operation.

WARNING:
LEAKAGE CURRENT TEST: The interconnection of auxiliary equipment with this device may increase the total leakage current. When interfacing with other equipment, a test for leakage current must be performed by qualified biomedical engineering personnel before using with patients. Serious injury or death could result if the leakage current exceeds applicable standards. The use of accessory equipment not complying with the equivalent safety requirements of this equipment may lead to a reduced level of safety of the resulting system. Consideration relating to the choice shall include: use of the accessory in the patient vicinity; and evidence that the safety certification of the accessory has been performed in accordance with the appropriate EN60601.1 harmonized national standard.

WARNING:
LINE ISOLATION MONITOR TRANSIENTS: Line isolation monitor transients may resemble actual cardiac waveforms, and thus cause incorrect heart rate determinations and alarm activation (or inhibition).

WARNING:
MRI USE: Do not use the electrodes during MRI scanning. Conducted current could potentially cause burns.

WARNING:
PATIENT CABLES AND LEADWIRES: Do not use patient cables and electrode leads that permit direct connection to electrical sources. Use only "safety" cables and leadwires. Use of non-safety patient cables and leadwires creates risk of inappropriate electrical connection which may cause patient shock or death.

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WARNING:
PACEMAKER PATIENTS: Rate meters may continue to count the pacemaker rate during occurrences of cardiac arrest or some arrhythmias. Do not rely entirely upon rate meter alarms. Keep pacemaker patients under close surveillance. For disclosure of the pacemaker pulse rejection capability of the monitor, refer to Appendix A.

WARNING:
RF INTERFACE: Known RF sources, such as cell phones, radio or TV stations, and two-way radios, may cause unexpected or adverse operation of this device.

WARNING:
SIMULTANEOUS DEVICES: Do not simultaneously connect more than one device that uses electrodes to detect ECG and/or respiration to the same patient. Use of more than one device in this manner may cause improper operation of one or more of the devices.

WARNING:
STRANGULATION: Make sure all patient cables, leadwires, and tubing are positioned away from the patient's head to minimize the risk of accidental strangulation.

WARNING:
WATER BIRTHS: Do not use the monitor to directly monitor patients during water births, in whirlpool or submersion water baths, during showers, or in any other situation where the mother is immersed in water. Doing so may result in electrical shock hazard.

WARNING:
EXTERNAL VGA CONNECTIONS: Connect only to GE-recommended display. ONLY remove cover plate if external display is used.

WARNING:
TELEMETRY CONNECTIONS: Connect only to GE-recommended telemetry system. Contact your GE service representative for more information.

WARNING:
COLOR DISPLAY: Certain colors may have limited visibility at a distance. Color-blind individuals may experience this more often.

WARNING:
EXERGEN® TAT-5000™: Cable assembly 2036641-001, 2036641-002, 2036641-003, and 2036641-004 cannot be field serviced. Do NOT attempt any repairs to this assembly. This assembly must be returned to the factory for any repairs. This assembly, as shipped, is important to patient safety.

WARNING:
DISPOSAL: This product consists of devices that may contain mercury, which must be recycled or disposed of in accordance with local, state, or country laws. (Within this system, the backlight lamps in the monitor contain mercury).

CAUTION:
ANNUAL SERVICING: For continued safety and performance of the monitor, verify the calibration, accuracy, and electrical safety of the monitor annually. Contact your GE service representative.

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CAUTION:
DAILY TESTING: It is essential that the monitor and accessories be inspected every day. It is recommended practice to initiate the monitor's selftest feature at the beginning of each monitoring session.

CAUTION:
ENVIRONMENT: The performance of the monitor has not been tested in certain areas, such as x-ray and imaging suites. The monitor is not recommended for use in these environments.

CAUTION:
EQUIPMENT CONFIGURATION: The equipment or system should not be used adjacent to, or stacked with, other equipment. If adjacent or stacked use is necessary, the equipment or system should be tested to verify normal operation in the configuration in which it is being used.

CAUTION:
PERFORMANCE: Report all problems experienced with the monitor. If the monitor is not working properly, contact your service representative for service. The monitor should not be used if it is not working properly.

CAUTION:
PINCHING: Keep fingers clear of the paper roller because the roller could pinch your fingers.

CAUTION:
STATIC ELECTRICITY: This assembly is extremely static sensitive and should be handled using electrostatic discharge precautions.

CAUTION:
TRAPPING: Keep hands, hair, jewelry, and loose clothing away from the paper roller because the roller could trap these items.

CAUTION:
TRIPPING: Arrange monitoring equipment so that cords and cables do not present a tripping hazard.

Electromagnetic Interference

This device has been tested and found to comply with the limits for medical devices to the IEC 60601-1-2: 2007, EN60601-1-2:2007, Medical Device Directive 93/42/EEC. These limits are designed to provide reasonable protection against harmful interference in a typical medical installation.

However, because of the proliferation of radio-frequency transmitting equipment and other sources of electrical noise in the health-care and home environments (for example, cellular phones, mobile two-way radios, electrical appliances), it is possible that high levels of such interference due to close proximity or strength of a source, may result in disruption of performance of this device.

Refer to the Electromagnetic Immunity information in this product's service manual for EN 60601-1-2 (2007) Edition 3 compliance information and safety information for this product.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with these instructions, may cause harmful interference with other devices in the vicinity. Disruption or interference may be evidenced in the form of erratic readings, cessation of operation, or incorrect

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functioning. If this occurs, the site of use should be surveyed to determine the source of this disruption, and actions taken to eliminate the source.

The user is encouraged to try to correct the interference by one or more of the following measures:

- Turn equipment in the vicinity off and on to isolate the offending equipment.
- Reorient or relocate the other receiving device.
- Increase the separation between the interfering equipment and this equipment.
- If assistance is required, contact your GE service representative.

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Chapter 1: System Description

1.1 System Overview

The Corometrics™ 250cx Series monitor is a medical device for monitoring maternal/fetal parameters (Fetal Heart Rate, Uterine Activity, Maternal Non-Invasive Blood Pressure, Maternal Pulse Oximetry, and Maternal/Fetal ECG) in labor and delivery (antepartum, intrapartum, and postpartum care). The monitor is equipped with an LCD display, which provides simultaneous display of fetal and maternal parameters plus the maternal waveforms, and a recorder, which prints continuous trends and alphanumeric data on one strip chart. The system is compatible with Centricity® Perinatal Clinical Information Systems and other information systems to streamline capture and archiving of patient data.

The Corometrics™ 250cx Series monitors are offered in two models:

1. Maternal/Fetal monitor (Corometrics™ 259cx): This model supports two Fetal Heart Rate (FHR) channels, Uterine Activity (TOCO or IUP), Maternal Non-Invasive Blood Pressure (NIBP), Maternal Pulse Oximetry ($MSpO_2$), Fetal ECG (FECG), and Maternal ECG (MECG).

2. Fetal monitor (Corometrics™ 256cx): This model supports two Fetal Heart Rate (FHR) channels, Uterine Activity (TOCO or IUP), and Fetal ECG (FECG).

Table 1-1: Monitor Models and Features

Monitor Model	Features
Maternal/Fetal monitor (Corometrics™ 259cx)	US, US2, TOCO, IUP, FECG, MECG, NIBP, $MSpO_2$
Fetal Only monitor (Corometrics™ 256cx)	US, US2, TOCO, IUP, FECG

Below optional components are also available to order:

A. Software Upgrade CD: The CD can be purchased to upgrade the monitor software to the latest version using the RS-232 serial port of the monitor.

B. Spectra Alerts option: Each monitor unit can be upgraded to include Spectra Alerts option. This feature analyzes heart rate and uterine activity data to detect certain abnormal trends and alert the clinician.

C. Fetal Movement Detection option: Each monitor unit can be software upgraded to include the Fetal Movement Detection (FMD) software option. This feature is designed to detect gross fetal body movements and body movements with associated limb movement.

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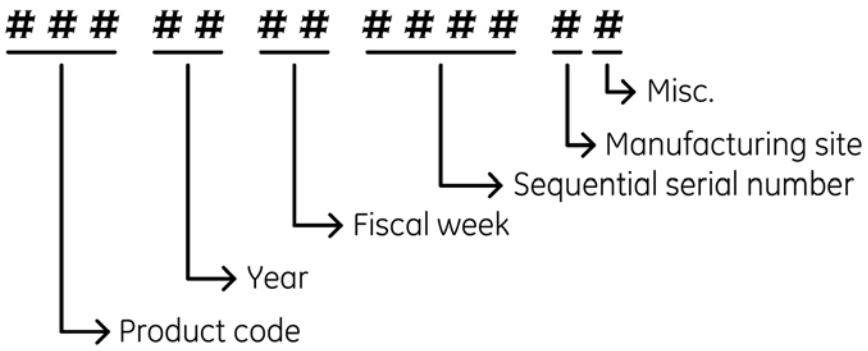
Each monitor unit has its unique 13-Digit product serial number which contains embedded information about the unit manufacturing date and site (See Figure 1-1).



Product Code	Description
SDJ	259CX-A (Nellcor, India Build)
SDK	259CX-B (Nellcor, US Build)
SDL	259CX-C (Masimo, India Build)
SDM	259CX-D (Masimo, US Build)
SDR	259CX-X (India Build)

Figure 1-1 Global Serial Number Format (13-Digit)

NOTE: For the refurbished (Gold Seal) Corometrics™ 259cx units, the unit serial number ends with letter "R" and the the serial number label of the unit includes the text "259CX REMANUFACTURED".

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1.2 Front Panel Controls, Indicators, and Connectors

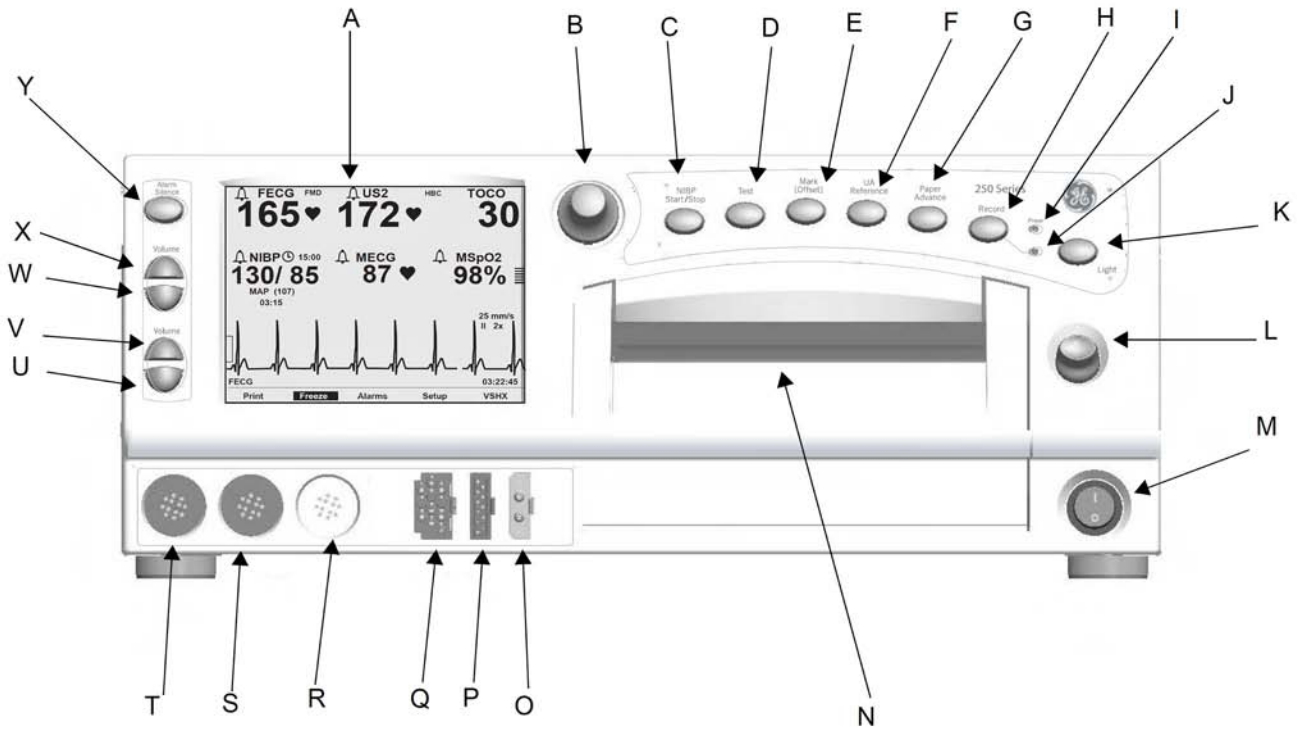

Figure 1-2 Front Panel View

A. Display: The monitor display is divided into several sections. The content and layout of the display can change, depending on which functions are installed in the monitor and the modes of operation in use.

B. Trim Knob Control: Operation of the monitor is controlled by using the front panel buttons in conjunction with the Trim Knob Control. This control selects softkeys on the display and positions a cursor within a setup screen. Rotate the Trim Knob Control left or right to highlight items on the screen with a bar cursor. After highlighting the desired item, press the Trim Knob Control to make the selection. In summary, rotate to move cursor and press to select an item.

C. NIBP Start/Stop Button: This button starts and stops both manual and automatic blood pressure determinations. Pressing and holding this button provides a "shortcut" for changing the interval time of the NIBP cycle in the automatic mode.

D. Test Button: Pressing this button starts or stops a monitor self-test routine.

E. Mark [Offset] Button: The Mark [Offset] button is a multi-function button:

- Mark: Pressing this button prints an event mark (T) on the bottom two lines of the top grid on the strip chart paper.
- Offset: When the Heart Rate Offset mode is enabled, pressing and holding this button shifts the secondary FHR trend +20 bpm for visibility purposes.

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F. UA Reference Button: This button sets a baseline for uterine activity pressure monitoring.

G. Paper Advance Button: Pressing this button advances the strip chart paper at a rate of 40 cm/min for as long as the button is held down.

H. Record Button: This button selects one of three recorder states: on, maternal-only mode, or off.

I. Power Indicator: This LED indicator illuminates in green when the monitor is turned on.

J. Recorder Indicator: This LED indicator shows the status of the recorder as per below table:

Recorder Indicator Status	What It Means
On	Recorder is on.
Off	Recorder is off.
Three short flashes every 5 seconds	Recorder is in maternal-only mode.
Flashes on and off	Error condition

K. Light Button: This button illuminates the strip chart paper for better visibility.

L. Record Door Latch: This latch opens the strip chart recorder door for adding, removing, or adjusting the paper.

M. Power Switch: Moving this switch to the ON position (I) turns on the monitor; moving the switch to the OFF position (O) turns off the monitor.

N. Strip Chart Recorder: The recorder prints annotations and trends on the strip chart paper. Two paper styles are available.

O. Maternal NIBP Connector: This connector is for attaching the blood pressure cuff.

P. Maternal SpO_2 Connector: Connect a 250cx Series $MSpO_2$ intermediate cable to this connector. Use only Nellcor Maternal Oxygen Saturation Sensors if Nellcor technology is installed in your monitor, or Masimo Sensors if Masimo technology is installed in your monitor.

Q. FECG/MECG Connector: Connect an FECG cable/legplate or MECG cable plug to this connector. Cables with rectangular plugs connect directly to the FECG/MECG connector. Cables with round plugs require an FECG/MECG adapter. This adapter is used for dual ECG monitoring too. The adapter branches into two cables, each with a round connector at the end: one branch is labeled MECG; the other branch is labeled FECG.

R. UA Connector: Connect a TOCO transducer or IUPC to this connector.

S. US2 Connector: Connect the secondary ultrasound transducer plug to this connector.

T. US Connector: Connect the primary ultrasound transducer plug to this connector.

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U. **Volume Button (FHR2 Decrease):** This button is used to decrease the fetal heart rate (FHR2) sound volume of the second ultrasound channel (US2). Volume settings have no effect on the processing used to determine heart rate. The Volume buttons work in conjunction with the volume control settings on the *US/US2 Setup* screen and on the *FECG Setup* screen.

V. **Volume Button (FHR2 Increase)**: This button is used to increase the fetal heart rate (FHR2) sound volume of the second ultrasound channel (US2). Volume settings have no effect on the processing used to determine heart rate. The Volume buttons work in conjunction with the volume control settings on the *US/US2 Setup* screen and on the *FECG* Setup screen.

W. **Volume Button (FHR1 Decrease):** This button is used to decrease the fetal heart rate (FHR1) sound volume of the primary ultrasound channel (US). Volume settings have no effect on the processing used to determine heart rate. The Volume buttons work in conjunction with the volume control settings on the *US/US2 Setup* screen and on the *FECG Setup* screen.

X. **Volume Button (FHR1 Increase):** This button is used to increase the fetal heart rate (FHR1) sound volume of the primary ultrasound channel (US). Volume settings have no effect on the processing used to determine heart rate. The Volume buttons work in conjunction with the volume control settings on the *US/US2 Setup* screen and on the *FECG Setup* screen.

Y. **Alarm Silence Button:** Pressing this button silences the audible indication of an individual alarm.

1.3 Display Description

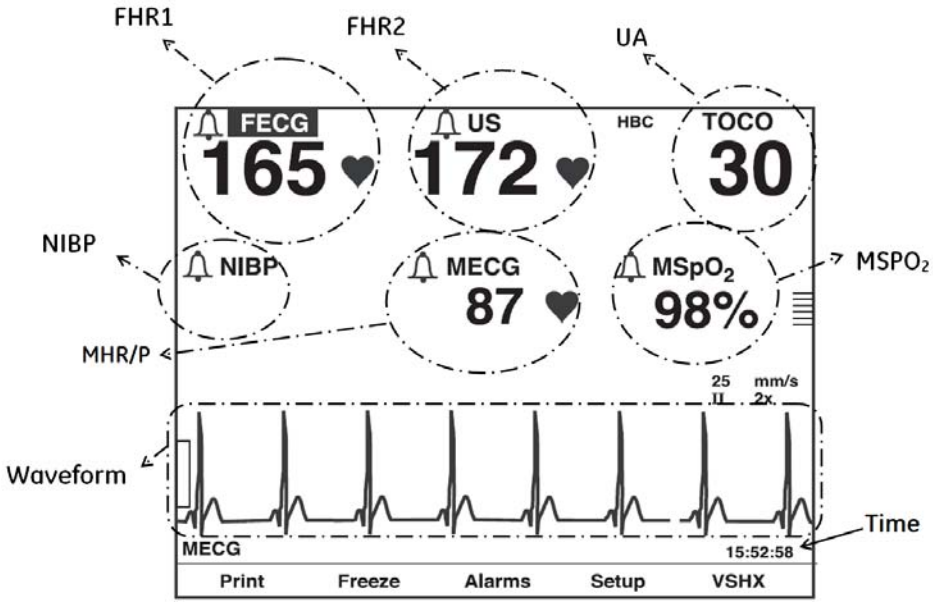

Figure 1-3 Display Information Example

Display Example: The graphic in Figure 1-3 gives the following information:

- Blood pressure (NIBP) is not active as indicated by the absence of numerics.
- Maternal pulse oximetry ($MSpO_2$) is active by presence of pulse amplitude indicator.
- MECG is selected as the heart rate source as indicated by the *MECG* mode title softkey—rather than *Pulse*.
- The MECG waveform is displayed at 25 mm/sec, at a size of *2x*, with lead II selected
- Heartbeat coincidence is enabled as indicated by the *HBC* acronym in the primary labor parameters area.
- All alarms are enabled as indicated by 🔔 symbol.

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The monitor LCD display is designed to show the information listed below:

1.3.1 Primary Labor Parameters

These parameters, shown on the upper portion of the screen (See Figure 1-3), include Fetal Heart Rate 1 (FHR1), Fetal Heart Rate 2 (FHR2), and Uterine Activity (UA). Each parameter can have several modes depending on the type of its input.

Parameter	Parameter Mode
Fetal Heart Rate 1 (FHR1)	US, US2, FECG, or INOP
Fetal Heart Rate 2 (FHR2)	US, US2, or INOP
Uterine Activity (UA)	TOCO, IUP, or INOP

For FHR1 and FHR2 parameters, the FHR value is shown in beats per minute and the FHR mode is displayed above the FHR value. For UA parameter, the UA value is shown in a user-selectable unit (mmHg or kPa) and the UA mode is displayed above the UA value.

1.3.2 Additional Parameters

These parameters, shown on the middle portion of the screen (See Figure 1-3) are available in Maternal/Fetal monitor models only. The parameters include Maternal Blood Pressure, Maternal Heart/Pulse Rate, and Maternal SpO_2. Each parameter can have several modes depending on the type of its input.

Parameter	Parameter Mode
Maternal Blood Pressure	NIBP
Maternal Heart/Pulse Rate	MECG, Pulse, or INOP
Maternal SpO_2	$MSpO_2$

1.3.3 Waveform

The monitor display can show Fetal ECG Waveform, Maternal ECG Waveform, or Maternal SpO_2 Pulsatile Waveform on the bottom portion of the screen (See Figure 1-3). So the waveform can have several modes: FECG, MECG, $MSpO_2$, or Off.

1.3.4 Time

The display also shows Current Time, [Label] *Frozen* Message and Time of Activation (See Figure 1-3).

1.3.5 Softkeys

The display includes several system configuration softkey controls (See Figure 1-4). A softkey is an area on the screen that can be selected with the Trim Knob Control. When the softkey is activated by pressing the Trim Knob Control, it may cycle through available settings or it may display a setup screen.

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Description of softkeys:

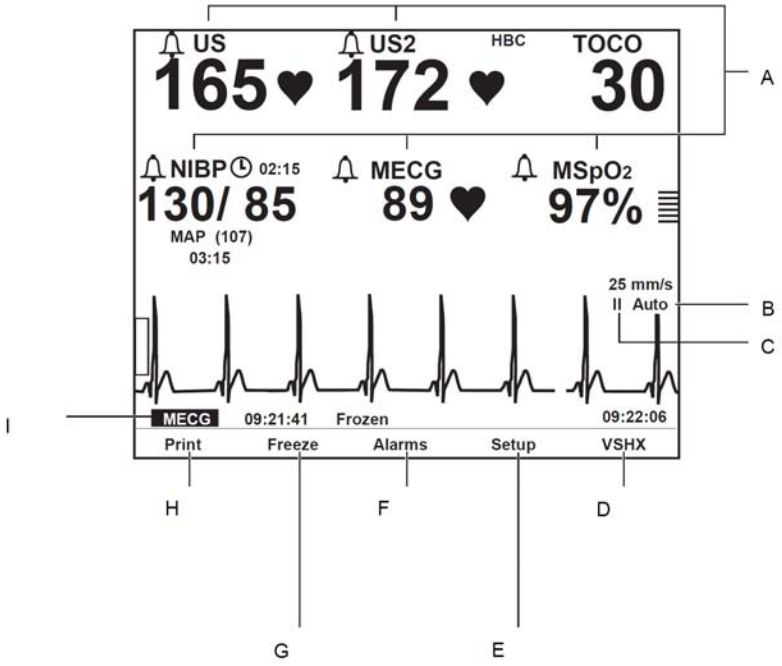

Figure 1-4 Display Softkeys

A. Mode Title Softkeys: Selects *US, US2, FECG, NIBP, MHR/P,* or *MSpO$_2$ Setup* screens.

B. ECG Scale Softkey: Selects *0.25x, 0.5x, 1x, 2x, 4x*, or *Auto*.

C. MECG Lead Softkey: Selects Lead *I, II*, or *III*.

D. VSHX Softkey: Displays maternal *Vital Signs History* screen (See Figure 1-5).

E. Setup Softkey: Displays *General Setup* screen.

NOTE: For detailed information on setup screens, refer to Appendix E.

F. Alarms Softkey: Displays Master *Alarm Setup* screen.

G. Freeze Softkey: Freezes waveform for analysis; unfreezes waveform to return to real-time display.

H. Print Softkey: Prints 6-second snapshot of frozen waveform, real-time waveform, or maternal vital signs history.

I. Waveform Softkey: Selects *FECG, MECG, MSpO$_2$*, or *Off*.

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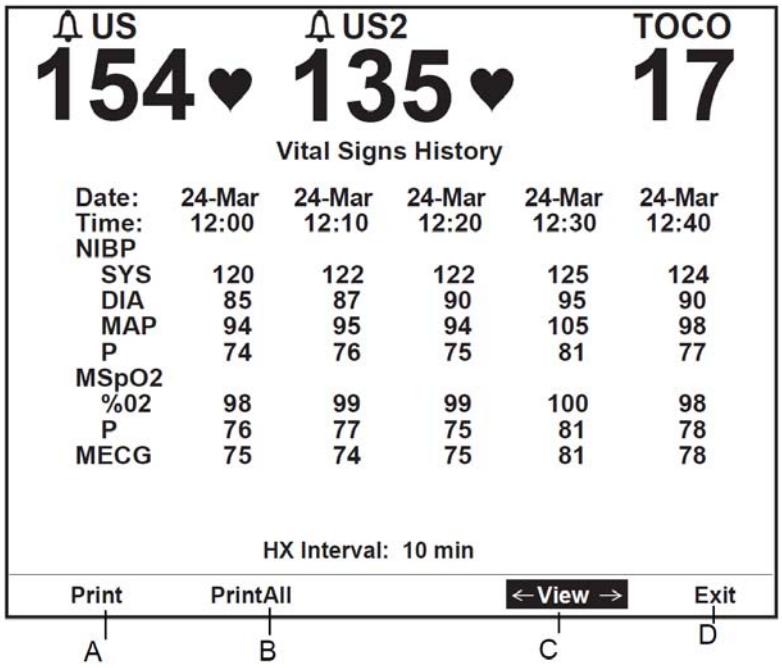

Figure 1-5 Maternal Vital Signs History Screen Softkeys

A. Print Softkey: Prints one page (screen) of the table.

B. PrintAll Softkey: Prints all pages (screens).

C. View Softkey: Scrolls through the data Counterclockwise for newest data or Clockwise for oldest data

D. Exit Softkey: Returns to the previous screen.

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1.4 Rear Panel Descriptions

CAUTION:
The maximum nondestructive voltage that may be applied to the rear panel connectors is 0 volts. Do not connect cables to these connectors without ensuring the connectors comply with leakage-current requirements of one of the following applicable standards: UL 60601-1, CSA C22.2 No. 601.1 or IEC/EN 60601-1.

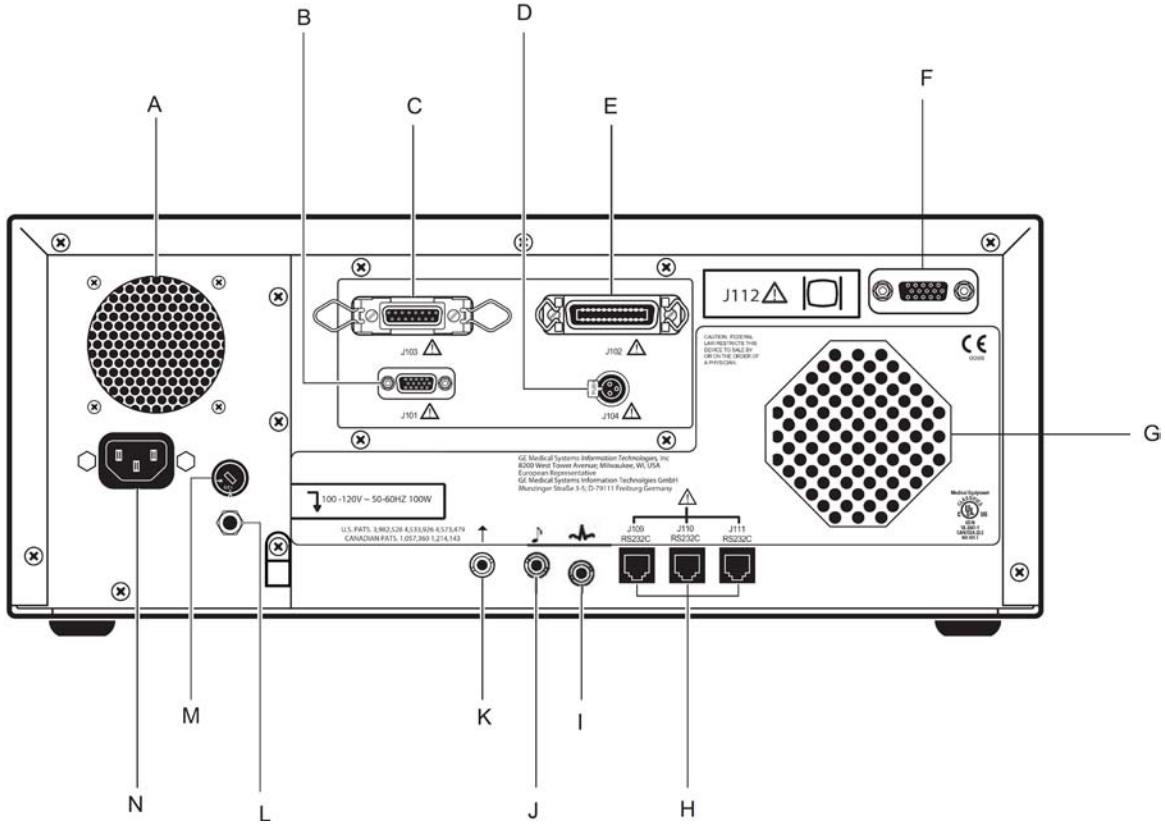

Figure 1-6 Rear Panel View

A. Vent: Provides ventilation for the monitor internal circuitry.

B. Telemetry Connector (J101): Connector for Corometrics™ 340 or Mini Telemetry system interface.

C. Data Entry Connector (J103): This connector is specifically designed for connecting to the legacy Corometrics™ 2116B Data-Entry/Clinical-Notes Keyboard.

D. Nurse Call System (J104): This connector attaches to a standard Nurse Call System. The connector's maximum output is 50 Vdc at 100 mA and the maximum on resistance is 0.5 Ω. When connected to a Nurse Call System, the monitor will activate the system each time a Spectra Alert is issued. This interface simulates pressing the button on a bedside Nurse Call System allowing nurses to respond to

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patient needs quickly and efficiently. Although the J104 Nurse Call connector is physically present on the optional communications package, this connector is only supported as part of the Spectra Alerts option. The Spectra Alerts or Fetal Alarms can be enabled/disabled in *Install Options Screen 2* in service mode screens (Refer to Fetal Alerts/Alarms description under See Figure E-3).

E. Central Systems Connector (J102): This Centronics-type connector is designed for interfacing to a legacy Corometrics Spectra 400 Central Surveillance and Alert System or other compatible analog central information system. This connector is often referred to as the Analog Interface Connector.

F. External VGA Connector (J112): This 15-pin sub-D connector is for interfacing to an external VGA display. Use of GE-recommended external display will allow monitor front panel display video to be replicated remotely.

G. Speaker: The rear panel speaker emits audible tones for heart rates, $MSpO_2$ pulse with $\%O_2$-dependent pitch, and alarms. It also provides the sound for the song player feature.

H. Communication Connectors (J109, J110, J111): These RJ-11 connectors provide three RS-232C serial interfaces that allow connecting the monitor unit to the following peripheral devices:

- Nellcor Puritan Bennett (NPB) N-200 Maternal Oxygen Saturation Monitor (J109 and J111 only)
- DINAMAP® PRO Series 100-400 Monitors
- DINAMAP® ProCare, V100 Monitors
- Quantitative Sentinel/Perinatal System (any RS-232C connector)

Upon shipping from the factory, all three ports are configured as follows:

- Communication Mode = 1371/Notes
- baudrate (bps) = 2400

At the above settings, connectors J109 and J111 are ready for connection to an NPB Model N-200. Connector J110 does not support a connection to NPB monitors. Therefore, this connector will have to be configured to communicate to the peripheral device.

Pin Number	Signal Name
1	RTS
2	RXD
3	GND
4	GND
5	TXD
6	CTS

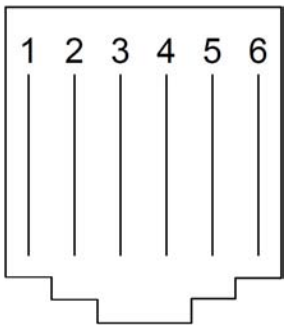

Figure 1-7 J109, J110, J111 Pin Numbers and Names

I. ECG Out Connector: This 3-conductor stereo phone jack allows recording of FECG or MECG trends on an external recorder. ECG signals are output at +80 dB with a bandwidth of 1.0 to 100 Hz. MECG signals

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are output at +60 dB with a bandwidth of 0.5 to 40 Hz. The output level from this port is 10 V/mV for FECG and 1 V/mV for MECG.

J. **Fetal Acoustic Stimulator Connector**: Connector for Corometrics™ 146 Fetal Acoustic Stimulator (FAST). A musical note symbol (♪)prints on the strip chart paper each time Corometrics™ 146 is used.

K. **Remote Event Marker Connector:** This connector is for connection to an optional Corometrics Remote Event Marker which is used to annotate the strip chart paper in the recorder with a mark. The mark can be configured as one of the below:

- The event symbol (↑) to record an "event"
- The fetal movement symbol (FM ↑) to record the perceived fetal movement occurrence by the mother. This is the default setting.

L. **Equipotential Lug**: A binding post terminal is directly connected to the chassis for use as an equipotential connection.

M. **AC Voltage Selection Switch**: This switch is intended for authorized service personnel to select the proper voltage for the AC input:

- 120: Lets the unit accept an AC input in the range of 100–120 VAC.
- 240: Lets the unit accept an AC input in the range of 220–240 VAC.

N. **Power Inlet Module:** AC line power cord connector.

1.5 Peripherals Description

This section provides information about the peripheral systems that can be attached to the Corometrics™ 250cx Series monitors.

1.5.1 Corometrics™ 340 Telemetry and Mini Telemetry

Corometrics™ 250cx Series monitor can be interfaced to a Corometrics™ 340 Telemetry system (receiver) or a Mini Telemetry system (receiver) thought J101 connector on the rear side of the monitor. Upon connecting the monitor to either telemetry systems, a "telemetry connected" symbol ( ) will appear beneath FHR1 field on the display when both the telemetry system and the monitor are turned on and the telemetry receiver detects an active FECG, MECG, US, TOCO, or IUP mode from its corresponding transmitter. The "telemetry connected" symbol will also be printed on the bottom line of the top grid of the strip chart paper upon commencement of the telemetry monitoring and every 30 minutes along with the modes.

NOTE: When any telemetry mode (US, FECG, MECG, TOCO, or IUP) is detected, all equivalent front panel modes (US, US2, FECG, MECG, TOCO, or IUP) are ignored. You cannot "mix and match" telemetry and monitor modes.

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A "telemetry disconnected" symbol (⚠) will be printed on the strip chart paper if the telemetry receiver is unplugged from the monitor, or the telemetry system (transmitter or receiver) is turned off, or the telemetry receiver does not detect any active mode information from its corresponding transmitter.

1.5.2 Quantitative Sentinel/Perinatal System

Through this interface, the monitor outputs MHR data, FHR data, and UA data to a central information such as a Quantitative Sentinel/Perinatal System. Annotations made at the central station can be optionally printed on the strip chart paper of the monitor as summarized below (if the central station has the capability to send the command):

- Each message is preceded by a computer icon ( ).
- Messages are restricted to a maximum length of 50 characters.
- Lower-case letters are converted to upper-case letters.
- Non-standard characters are replaced with spaces.

The monitor can be configured with the remote annotation capability enabled (*1371/Notes* mode) or disabled (*1371* mode). Set the communication *Mode* to *1371* or *1371/Notes* and the *Baud rate* to the specified value by the manufacturer in the *Communication Setup* screen (See Figure E-4).

To connect a central information system:

1. Obtain an appropriate interface cable: connect one end to an available RS-232C connector (J109, J110, or J111) on the monitor unit. Connect the other end to the wall plate wired to the central information system. For a Quantitative Sentinel/Perinatal System: the interface cable is catalog number (REF) 1558AAO (10') or 1558BAO (20'); the corresponding wall plate connector is labeled RS-232 COMMUNICATIONS.

2. Access the *Communications Setup* service mode screen and set the baudrate and mode for the appropriate port to *1200 bps* and either the *1371* or *1371/Notes* mode, respectively. Then exit the service mode screens.

1.5.3 Exergen® TAT-5000™

Exergen® TAT-5000™ provides maternal temperature as a printout and vital signs history. Set the communication *Mode* to *Exergen* and the *Baud rate* to *4800* in the *Communication Setup screen* (See Figure E-4).

1.5.4 DINAMAP® Models PRO Series 100-400 and ProCare

All of the DINAMAP® Models PRO Series 100-400 ProCare, and V100 monitors can be interfaced to Corometrics™ 250cx Series monitors using an ILC-1926 interface, one DINAMAP V-Link cable assembly (Part number: 683235), and one Corometrics™ DINAMAP serial cable (Part number: 2007234-001) to provide a printout of the NIBP parameter on the strip chart paper. Set the communication *Mode* to *Critikon* and the *Baud rate* to the specified value by the manufacturer in the *Communication Setup* screen (See Figure E-4).

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1.6 Theory of Operation

The Corometrics™ 250cx Series system is made up of front-end and back-end sections, system power supply, and recorder module. The Main board forms the heart of the monitor control functions. The Main board along with the communications board forms the back-end section of the monitor. The front-end section boards are housed in the sealed front-end card cage and consist of FECG/UA board, MECG board, Dual ultrasound board, SpO_2 carrier board, $MSpO_2$ connector board, and the Frond-end motherboard. The DSP/Display board is the bridge between the front-end and back-end sections. The recorder assembly houses the recorder board.

Figure 1-8 depicts the system block diagram of the monitor unit and illustrates all the boards, external parts, their connections (cable or direct plug-in), isolated areas, and the functionalities of the boards.

Upon power-up, the Corometrics™ 250cx Series monitor automatically performs a number of tests to verify the integrity of the system memory, processor, and voltage levels before allowing the monitor to enter the normal operational mode. The pulse oximetry module is also tested (and automatically calibrated) upon power up or whenever the module is reset. After setting the Power switch to the on (I) position, the tests run for approximately 2 seconds. If all tests pass, the monitor enters the normal operational mode.

1.6.1 Digital System Processor (DSP) / Display Board

The DSP/Display board consists of two independent functioning sub-circuits: the DSP sub-circuit and the Display interface sub-circuit.

The DSP circuitry processes analog and digital data from the front-end modules and interfaces to the main processor. The ECG and ultrasound analog information is processed and heart rates are output to the Main board via a shared memory. Digital pressure information is received, processed, and also sent to the shared memory.

The Display sub-circuit, consisting mainly of a shared memory and timing generator, provides the interface between the LCD and the main processor. Circuitry for the main processor to adjust the brightness of the LCD is provided through a DC-to-AC inverter. RS-232 communications between the Main board and the UI keypad board are routed through the DSP board.

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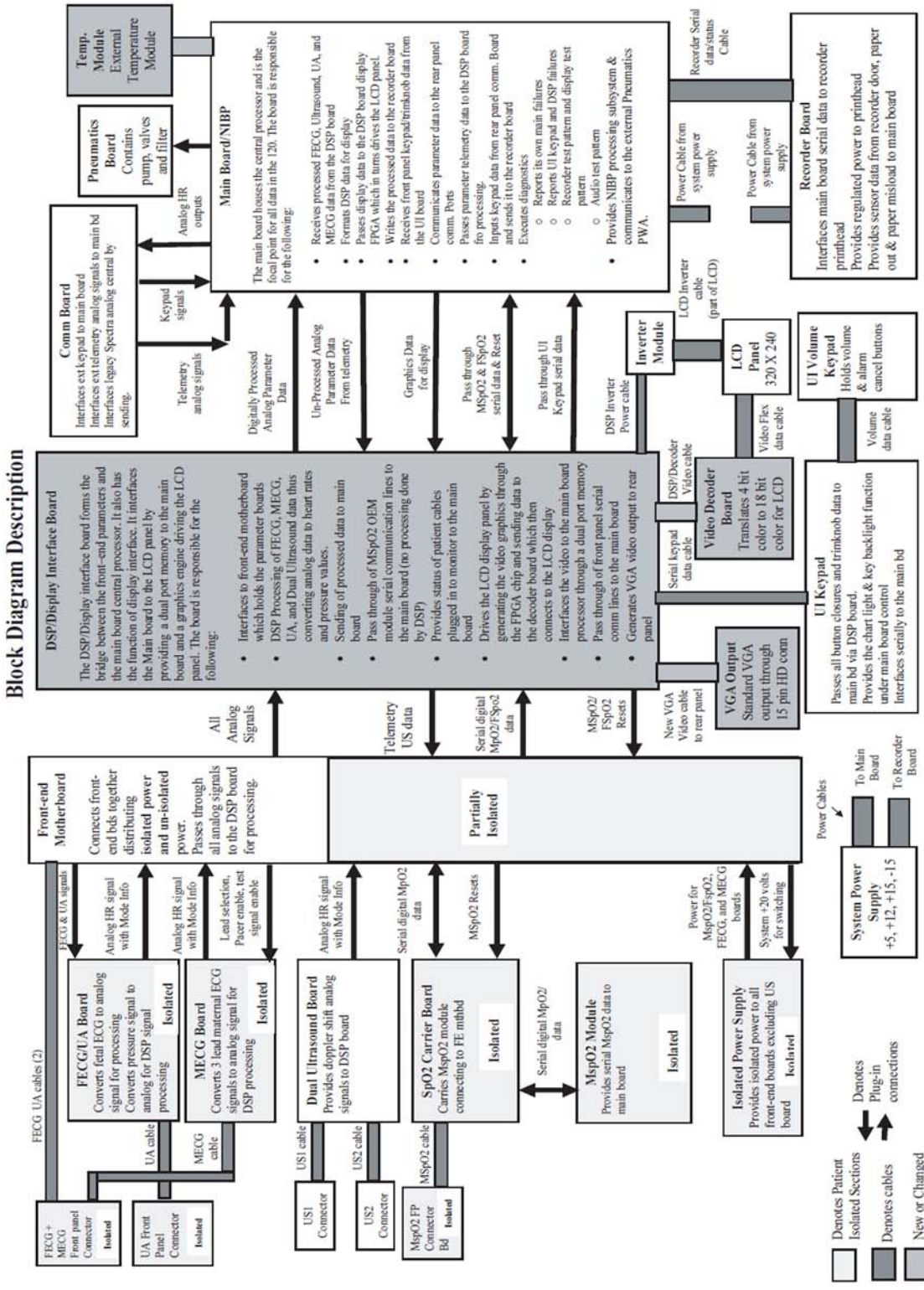
Block Diagram Description
DSP/Display Interface Board
The DSP/Display interface board forms the bridge between the front-end parameters and the main board central processor. It also has the function of display interface. It interfaces the Main board to the LCD panel by providing a dual port memory to the main board and a graphics engine driving the LCD panel. The board is responsible for the following:
Interfaces to front-end motherboard which holds the parameter boards
DSP Processing of FECG, MECG, UA, and Dual Ultrasound data thus converting analog data to heart rates and pressure values.
Sending of processed data to main board
Pass through of MSpO2 OEM module serial communication lines to the main board (no processing done by DSP)
Provides status of patient cables plugged in to monitor to the main board
Drives the LCD display panel by generating the video graphics through the FPGA chip and sending data to the decoder board which then connects to the LCD display
Interfaces the video to the main board processor through a dual port memory
Pass through of front panel serial comm lines to the main board
Generates VGA video output to rear panel
Comm Board
Interfaces ext keypad to main board
Interfaces ext telemetry analog signals to main bd
Interfaces legacy Spectra analog central by sending.
Main Board/NIBP
The main board houses the central processor and is the focal point for all data in the 120. The board is responsible for the following:
Receives processed FECG, Ultrasound, UA, and MECG data from the DSP board
Formats DSP data for display
Passes display data to the DSP board display FPGA which in turns drives the LCD panel.
Writes the processed data to the recorder board
Receives front panel keypad/trimknob data from the UI board
Communicates parameter data to the rear panel comm. Ports
Passes parameter telemetry data to the DSP board fro processing.
Inputs keypad data from rear panel comm. Board and sends it to the recorder board
Executes diagnostics
Reports its own main failures
Reports UI keypad and DSP failures
Recorder test pattern and display test pattern
Audio test pattern
Provides NIBP processing subsystem & communicates to the external Pneumatics PWA.
Temp. Module External Temperature Module
Pneumatics Board Contains pump, valves and filter
Analog HR outputs
Telemetry analog signals
Keypad signals
Digitally Processed Analog Parameter Data
Un-Processed Analog Parameter Data From telemetry
Graphics Data for display
Pass through MSpO2 & FSpO2 serial data & Reset
Pass through UI Keypad serial data
Power Cable from system power supply
Recorder Serial data/status Cable
Recorder Board
Interfaces main board serial data to recorder printhead
Provides regulated power to printhead
Provides sensor data from recorder door, paper out & paper misload to main board
Inverter Module
LCD Inverter cable (part of LCD)
LCD Panel 320 X 240
DSP Inverter Power cable
Video Flex data cable
UI Volume Keypad
Holds volume & alarm cancel buttons
Volume data cable
Serial keypad data cable
DSP/Decoder Video cable
Video Decoder Board
Translates 4 bit color to 18 bit color for LCD
UI Keypad
Passes all button closures and trimknob data to main bd via DSP board.
Provides the chart light & key backlight function under main board control
Interfaces serially to the main bd
VGA Output
Standard VGA output through 15 pin HD conn
New VGA Video cable to rear panel
All Analog Signals
Telemetry US data
Serial digital MpO2/FSpo2 data
MSpO2/ FSpO2 Resets
Front-end Motherboard
Connects front-end bds together distributing isolated power and un-isolated power. Passes through all analog signals to the DSP board for processing.
Partially Isolated
Power Cables
To Main Board
To Recorder Board
System Power Supply +5, +12, +15, -15
FECG/UA Board
Converts fetal ECG to analog signal for processing
Converts pressure signal to analog for DSP signal processing
Isolated
MECG Board
Converts 3 lead maternal ECG signals to analog signal for DSP processing
Isolated
Dual Ultrasound Board
Provides doppler shift analog signals to DSP board
SpO2 Carrier Board
Carries MspO2 module connecting to FE mthbd
Isolated
MspO2 Module
Provides serial MspO2 data to main board
Isolated
Isolated Power Supply
Provides isolated power to all front-end boards excluding US board
Isolated
FECG & UA signals
Analog HR signal with Mode Info
Analog HR signal with Mode Info
Lead selection, Pacer enable, test signal enable
Analog HR signal with Mode Info
Serial digital MpO2 data
MSpO2 Resets
Serial digital MpO2/ data
Power for MspO2/FspO2, FECG, and MECG boards
System +20 volts for switching
FECG UA cables (2)
UA cable
MECG cable
US1 cable
US2 cable
MSpO2 cable
FECG + MECG Front panel Connector
Isolated
UA Front Panel Connector
Isolated
US1 Connector
US2 Connector
MspO2 FP Connector Bd
Isolated
Denotes Patient Isolated Sections
Denotes cables
New or Changed for Cheetah
Denotes Plug-in connections

Figure 1-8 System Block Diagram

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1.6.2 Main Board

The Main board makes up the central processing unit for the monitor unit. The Main board accepts simultaneously processed parameters directly from four separate modules. The minimum configuration monitor has only the DSP board as an input module. Heart rate (ultrasound and or FECG), uterine activity data, mode information, and FMD data flow from the DSP board to the Main board via DSP board FPGA shared memory. Maternal and fetal Oximetry makes up the second and third modules. Information from these devices is passed to the Main board via RS-232 ports. The Main board communicates with the front panel UI keypad board using RS-232 interface, which is routed through the DSP board. The Main board also provides a master reset for the UI keypad board. The Main board holds the NIBP control circuitry (minus pump and valves) and communicates to it using a CMOS interface. The Main board connects to the Pneumatics board which holds the NIBP pump, valves, and filter. The Main board contains three external RS232 data ports for various external devices and setup/code update functions. The Main board receives data from the rear panel options board to allow the added Communication features. The Main board formats all the data and interfaces to the recorder board. The Main board also controls all of the audio functions including generated tones to passing ultrasound audio from the ultrasound board.

The Main board contains one dip switch pack (SW1) that determines some of the monitor configurations (See Table 1-2). The current settings of the SW1 switches can be checked without removing the unit top cover by accessing the Diagnostic Control screen (See section E.5), which displays the status of switches from left (i.e. switch number 8) to right (i.e. switch number 1). A "1" status means the corresponding switch is off and a "0" status means the corresponding switch is on. To change the switch settings, the unit top cover shall be removed to access the SW1 swtich. Below is an example of the SW1 switch status:

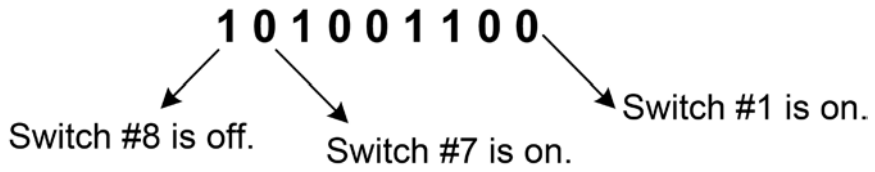

Table 1-2: SW1 Switch Settings

Switch Number	Switch Name & Description	Settings
1	Factory Test: For factory use only	Off = Enabled
2	J102 Output Levels: Select between J102 outputs compatible with HP or Corometrics™	Off = HP On = Corometrics™
4	NIBP Option: Enable/disable the maternal NIBP.	Off = Enabled
5	$MSpO_2$ Option: Select between the $MSpO_2$ options.	Nellcor: 5=Off, 6=Off Masimo: 5=On, 6=Off No $MSpO_2$: 5=On, 6=On
6		
7	Inactive	Inactive
8	MECG Option: Enable/disable the MECG option.	Off = Enabled

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1.6.3 User-Interface Keypad & Volume/Alarm Keypad Boards

The user-interface keypad board is responsible for two functions, a) input controls, and b) the recorder chart light feature. The board contains most of the front panel buttons (except for the volume and alarm cancel buttons) and receives input from the Trim Knob Control. The keypad is of the elastomeric type and utilizes backlight LEDs to light each key. The board also receives the volume/alarm keypad board inputs through an external cable, processes all key closures, and communicates the key statuses to the main processor. The Main board receives data from the main processor (routed through DSP/Display board) and controls the Recorder Indicator LED. The volume/alarm keypad board contains the volume and alarm key buttons and sends the button statuses to the user-interface keypad board. The volume/alarm keypad board is also of the elastomeric type and has backlight LEDs for each key. The user-interface keypad board interface with the Main board is through an RS-232 interface.

1.6.4 Video Decoder Board

The video decoder board interfaces between the DSP/Display board and the LCD panel. The video decoder board performs conversion of 4-bit color information from the FPGA output to the 18-bit color required by the LCD panel. This provides a 16-color palette. The translation is accomplished in the FPGA on the video decoder board. This board receives high-speed video from the DSP/Display board.

1.6.5 Recorder Board

The recorder board is responsible for driving the recorder motor and the recorder print head device along with providing the main system board with paper out/low/misload status. To drive the motor it receives pulses from the main system board and provides the proper drive circuitry to drive the stepper motor 4 phase windings. To drive the print head an adjustable power supply is provided which is set to the print head specifications (each print head is unique). Data to be printed and control information is received from the main system board, buffered and presented to the print head. Sensors from the recorder assembly to detect paper low/out/misload are received and translated to digital status lines to be sent to the main system board.

1.6.6 Communications Board

The communications board contains three basic interfaces. It supports the analog interface (J102) to the legacy Spectra 400 surveillance system as well as other manufacturer's centrals, a 2116 external keyboard interface for strip chart annotation, and an analog telemetry interface to the Corometric™ 340 or Mini Telemetry system. The communications board communicates to the system by directly plugging into the main system board. Digital data from the keypad interface and telemetry (modes only) is transferred through a data bus and analog signals (MECG, FECG, Ultrasound, TOCO) from the telemetry are separately routed through the Main board to the DSP for processing similarly to the existing front panel patient data.

1.6.7 MSpO$_2$ Connector Board

The MSpO$_2$ connector board receives the universal SpO$_2$ patient cables on the front bezel of the monitor unit and transfers the analog signals on to the internal SpO$_2$ cable that in turn connects to the SpO$_2$ Carrier board.

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All the signals entering this board are patient isolated and signals leaving this board though the $MSpO_2$ cable are also isolated.

1.6.8 $MSpO_2$ Carrier Board

The SpO_2 carrier board holds the SpO_2 module. It receives $MSpO_2$ patient cable connections from the universal front-end connector board and internal cable on its isolated side and routes them to the connected NELL3-S, Nellcor MP-506 or NELL-3, or Masimo MS-11 or MS-2011 modules. It supplies isolated power to the SpO_2 modules and transfers the isolated data generated by the modules using opto-couplers to the front-end motherboard on to the monitor system for processing. The monitor system is able to reset the maternal and the SpO_2 modules using opto-coupled reset lines.

1.6.9 FECG/UA Board

The FECG/UA board is made up of two separate isolated patient front-end sub-circuits: FECG and Uterine Activity. The FECG sub-circuit converts the low level signals received from the fetus through the spiral electrode to electrical impulses which are amplified, filtered, and sent across an isolation barrier. The un-isolated FECG signal then is further amplified and sent off the FECG board, routed by the front-end motherboard to the DSP/Display board, where it is digitized and processed. Additionally, the FECG mode line (cable plugged in sense line) from the ECG connector is digitized and sent over the barrier via an opto-coupler where it is routed similarly to the FECG analog signal.

The Uterine Activity sub-circuit processes the pressure signals from the external TOCO or IUP sensor (use same inputs), by amplifying and filtering the inputs, and then converts the signals via serial analog to digital (A/D) converter. The output of the A/D converter is then sent across the isolation barrier, routed through the front-end motherboard through to the DSP/Display board where it is further processed. Two mode lines from the UA patient connector are also digitized: TOCO present and IUP present (only one cable can be plugged in at a time). These signals are then sent over the barrier via an opto-coupler where they are routed similarly to the TOCO/IUP digitized signals.

1.6.10 MECG Board

The MECG board processes the isolated MECG signals present from the ECG front panel connector. The multi-lead signals first go through programmable lead switching circuitry controlled by the DSP processor. The MECG signal is then amplified and filtered and sent across the isolation barrier where it is routed through the front-end motherboard to the DSP/Display board, digitized and processed. The MECG board also contains an ECG test signal on the isolated side which is used when the monitor front panel test button is depressed. This tests most of the front-end circuitry paths. The MECG board also contains pacemaker detection circuitry allowing the monitor to blank out the pulses for proper counting.

1.6.11 Dual Ultrasound Board

The dual ultrasound board generates the ultrasound timing signals to pulse the external patient connected ultrasound transducer crystals and provides the necessary receive circuitry to detect the reflected waveforms. It does this by first demodulating the needed signal off of the carrier and filtering the signals which are then

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sent through the frontend motherboard to the DSP where they are digitized and processed. No isolation is present from the patient connector through the ultrasound board as the plastic ultrasound transducer forms the physical isolation barrier.

1.6.12 Isolated Power Supply Board

The isolated power supply board provides all of the isolated power for the FECG/UA board, MECG board and the carrier board which in turn feeds the two SpO_2 modules ($MSpO_2$). The ultrasound board is not powered from this board as it is not electrically isolated. The isolated power supply is made up of two isolated sets of supplies. One supply set is specifically for FECG on the FECG/UA board. The other isolated set of supplies powers the remaining functions including TOCO/IUP (on the FECG/UA board), MECG (MECG board), and the SpO_2 Carrier board (SpO_2 modules). The un-isolated power input to this PWA consists of +20 volts routed from the front-end motherboard through the DSP and Main board and then finally the system power supply.

1.6.13 Front-End Motherboard

The front-end motherboard is a passive inter-connection board which houses all of the front-end parameters except for NIBP. In addition to the parameters, it holds the isolated power supply. The board routes all of the isolated and un-isolated signals to and from the DSP/Display board. This includes both analog and digital parameter inputs and digital control outputs. On the front-end side it interfaces to the pressure channel front-end cable and the FECG front-end cable, which carries all of the FECG signals as well as the MECG mode lines. The MECG analog signals are routed separately from the front panel to the MECG daughter board. The $MSpO_2$ input signals enter the SpO_2 carrier board directly.

1.6.14 Memory Battery

Whenever the monitor is turned off, a battery provides power to the Random Access Memory (RAM) that stores information such as time, date, default settings, etc. An icon ( ) will appear in the upper right-hand section of the monitor display in the following circumstance:

A. RAM data corruption: The ( ) icon appears for a short period of time after the system power-up on the monitor display in data corruption conditions, which makes the monitor revert to the factory settings. To re-configure the settings, access the setup screens.

B. Bad Battery: The ( ) icon appears steadily after the system power-up on the monitor display when the RAM battery has reached end-of-life and needs to be replaced.

NOTE: Always set the time and date prior to the initial operation of the monitor after the RAM battery replacement. Update the settings during the daylight-saving time changes.

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Chapter 2: Installation

This chapter provides information required to install the Corometrics™ 250cx series monitor.

2.1 Time Required for Installation

The average installation time for the Corometrics™ 250cx series monitor is approximately 10 minutes. The required checkout procedures after installation takes approximately 30 minutes.

2.2 Environmental Requirements

The system shall be installed, serviced, and operated within the environmental conditions described in section A.1.

2.3 Tool Requirements

None

2.4 Installation Procedure

2.4.1 Strip Chart Recorder Paper Load

CAUTION:
Use GE-approved recorder paper only. Using the wrong paper may damage the recorder print head and product inferior print quality.

CAUTION:
The monitor recorder shall be loaded with the paper at all times. This reduces particle build-up on the print head and facilitates opening the recorder door.

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To load strip chart recorder paper perform below steps:

1. Press down the latch on the right side of the strip chart recorder door (See Figure 2-1).

2. Fan the pack of Z-fold paper on all sides to loosen any folds and to ensure proper feed of the paper through the recorder.

3. Hold the package of paper such that the black squares are on the bottom of the pack and the Corometrics logo and page numbers are on the left side of the pack (See Figure 2-2).

NOTE: The black squares indicate the end of the recorder paper. When the black squares appear, the strip chart recorder has approximately 20 minutes of paper remaining, when running at a speed of 3 cm/min.

4. Unfold two sheets from the top of the package so that they extend toward you (See Figure 2-3).

5. Place the pack of paper in the drawer so that the pack is in a flat position in the recorder (See Figure 2-4).

6. Slowly close the strip chart recorder door, being careful not to skew the paper ("Figure 2-5").

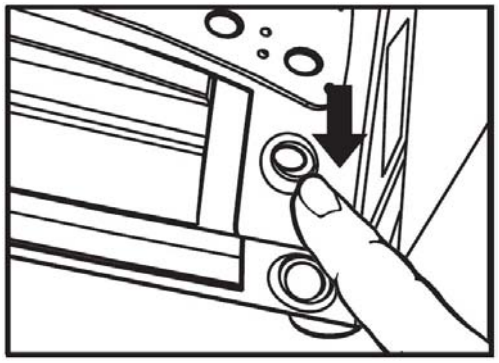

Figure 2-1

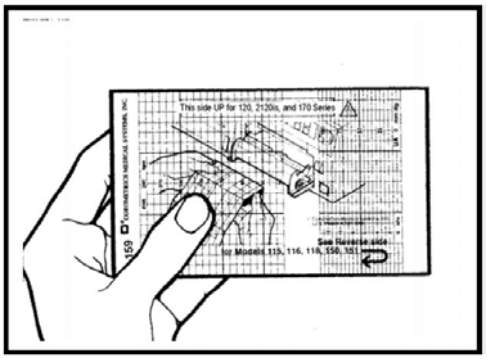

Figure 2-2

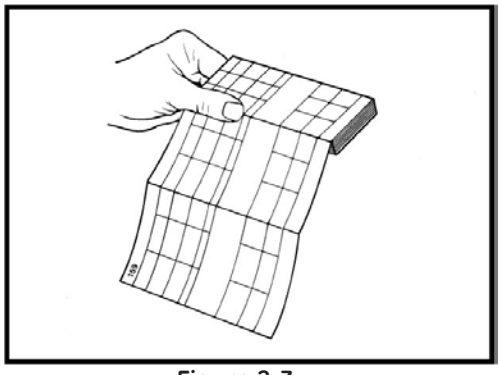

Figure 2-3

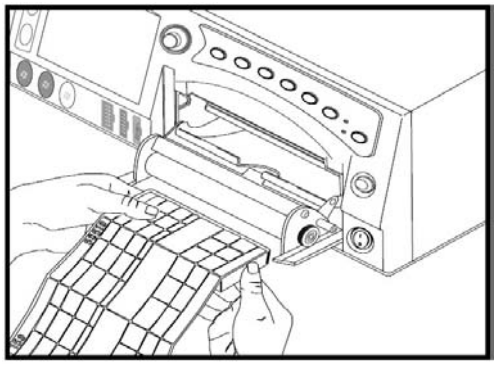

Figure 2-4

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2.4.2 Peripheral Connections

If present, connect the below optional peripherals to the Corometrics™ 250cx series monitor as per the following instructions:

Remote Event Marker: Plug the marker connector into its corresponding jack on the rear side of the monitor.

Corometric 340 Telemetry / Mini Telemetry system: Plug the interconnect cable (Part number: 1563AAO) into the Telemetry Connector (J101) on the rear side of the unit (Refer to Corometric 340 Telemetry / Mini Telemetry service manuals for installation details).

External Video Display: Plug the display cable into the External Display Connector (J112) on the rear side of the unit.

Quantitative Sentinel / Perinatal System: Plug the interface cable into an available RS-232C connector (J109, J110 or J111) on the rear side of the unit.

2.4.3 Power Cord Attachment

1. Confirm the monitor power switch is in off (O) position.

2. Connect the power cord to the power connector on the rear panel of the monitor and secure the power cord with the P Clamp (See Figure 2-6).

3. Verify that the AC voltage selector on the rear panel of the monitor is set to the correct country-specific voltage (See Figure 2-6).

CAUTION:
Incorrect setting of the AC voltage selector can damage the monitor.

4. Plug the power cord into a power outlet.

2.4.4 System Configuration

1. Turn the monitor on. Confirm that the Power indicator (green light) illuminates, the monitor display is on, and the monitor generates a series of tones, indicating that the unit has been turned on.

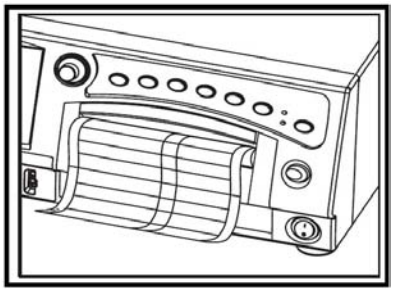

Figure 2-5

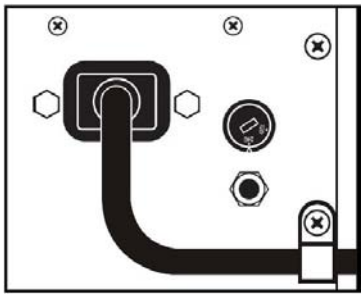

Figure 2-6

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2. Use the Trim Knob Control to select the *Setup* softkey to display the *General Setup* screen and set the correct date and time ("Figure 2-7"). Set the paper speed in accordance with the hospital or local requirements.

WARNING:
Incorrect paper speed setting results in inaccurate waveform prints on the strip chart paper.

3. Select the *Service* softkey on the screen to have the *Service Lock* screen with *0 0 0 0* access code displayed ("Figure 2-8").

4. Use the Trim Knob Control to enter the access code as either the current month or day (MMDD) or day and month (DDMM), depending on how the monitor is configured. For example, April 23 shall be entered as 0 4 2 3.

NOTE: To gain access to the service screens, the correct date and time must be set on the G*eneral Setup* screen.

5. Upon entering the access code, press the Trim Knob Control to access *Install Options Screen 1* screen. ("Figure 2-9").

6. Use the Trim Knob Control to navigate on the screen and change the factory default settings if necessary (See Appendix E for configuration setting details). Make sure to set the paper scaling to match with the type of paper used.

WARNING:
Incorrect paper scaling setting (mismatch between the paper scaling and type of paper used) results in invalid waveform prints on the strip chart paper.

7. If any peripherals are installed to communicate to the monitor through RS-232C connectors, use the Trim Knob Control to select the *COMM* softkey on *Install Options Screen 1* to access the *Communication Setup* screen ("Figure 2-10"). Use the Trim Knob Control to set the communication baud rates and modes to be compatible with the external peripheral device and then exit the screen. For more information on *Communication Setup* screen fields, refer to section E.4.

NOTE: For Quantitative Sentinel/Perinatal System, set the baud rate and mode for the appropriate port to 1200 bps and either the *1371* or *1371/Notes* respectively.

8. Use the Trim Knob Control to select the *NextPage* softkey to access the *Install Options Screen 2* screen and change the factory default settings if necessary. (See Appendix E for configuration setting details).

9. To store the changed configuration settings as the monitor default settings, use the Trim Knob Control to select *Store Current to Hospital* option on the *Install Options Screen 2* screen. Confirm the Default Setting option changes to *Hospital* ("Figure 2-11").

WARNING:
When the monitor is turned on or restarted, the configuration settings revert back to the Default Setting option selected, i.e. *Factory* or *Hospital*.

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10. Use the Trim Knob Control to select *Restart* softkey to accept the settings and reboot the unit.

11. Perform the checkout procedures as instructed in chapter 3 before putting the monitor into use.

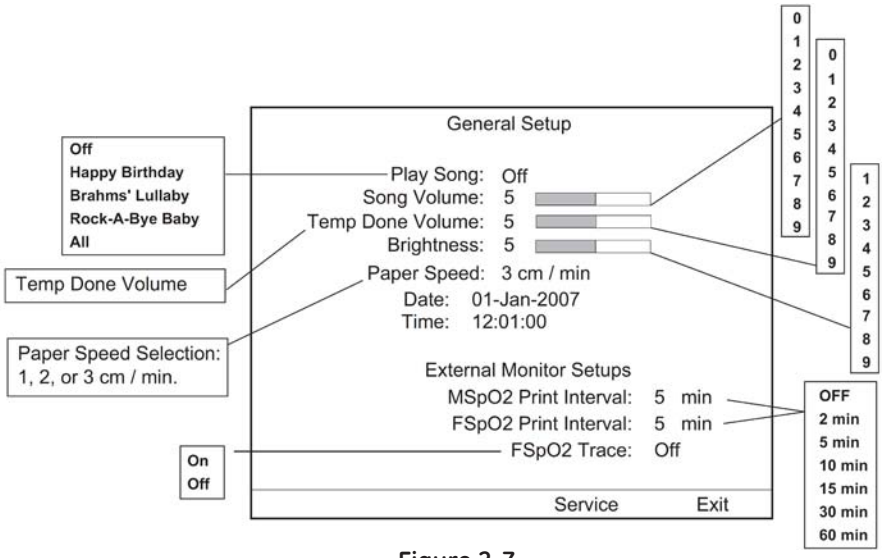

Figure 2-7

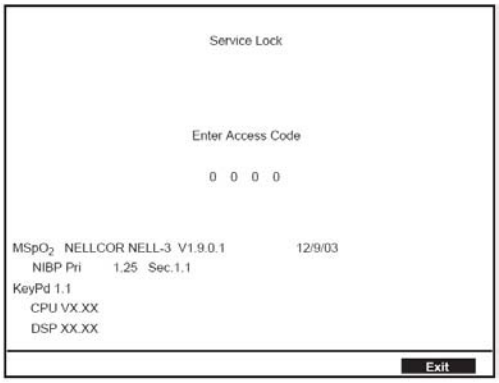

Figure 2-8

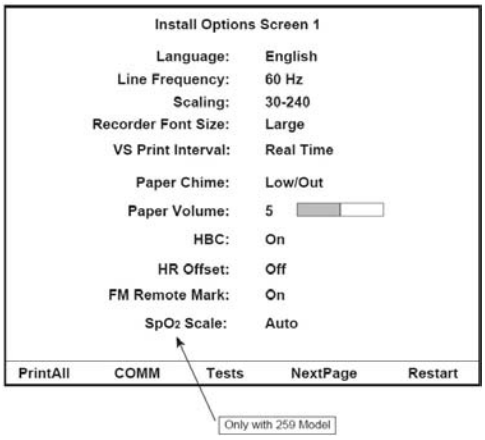

Figure 2-9

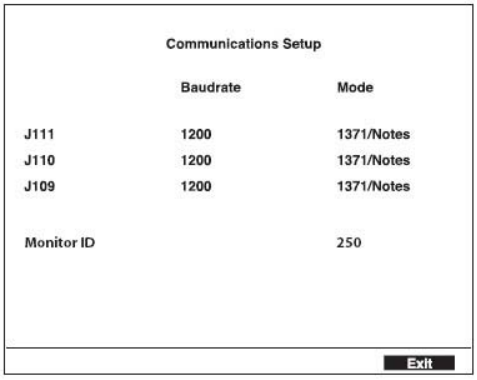

Figure 2-10

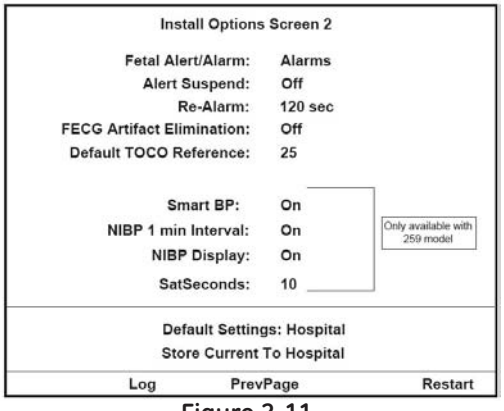

Figure 2-11

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Chapter 3: Maintenance and Checkout

This chapter includes planned maintenance procedures as well as checkout procedures required after Corometrics™ 250cx series product installation, repair, or maintenance. These procedures must be performed by authorized service personnel.

3.1 Procedures Schedule

Table 3-1 lists all planned maintenance and checkout procedures, specifies when and how often each procedure should be performed, and provides the approximate time taken to perform each procedure.

For good care and maintenance of the Corometrics™ 250cx series product, perform planned maintenance procedures at specific time intervals. The checkout procedures should be performed after any installation, repair, calibration, maintenance, or part replacement.

Table 3-1: Maintenance and Checkout Procedures Schedule

Procedure Name	Approximate Time	To Be Performed as Planned Maintenance	To Be Performed as Checkout after any Service*
Visual Inspection	2 minutes	Annually	YES
Cleaning	2 minutes	Annually	As needed
Transducers Checks	5 minutes	Annually	As needed
Functional Checks	20 minutes	Annually	YES
NIBP Calibration Check	8 minutes	Annually	As needed
Electrical Safety Tests	8 minutes	Annually	YES

* Service includes installation, repair, calibration, maintenance, or part replacement.

WARNING:
Do not service the Corometrics™ 250cx series unit while it is in clinical use.

CAUTION:
Table 3-1 shows the minimum frequencies required for maintenance. Always follow hospital and local regulations for required frequencies.

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3.1.1 Environmental Requirements

The system shall be installed, serviced, and operated within the environmental conditions described in section A.1.

3.2 Tool Requirements

The following table lists the service tools required to perform the planned maintenance and checkout procedures:

Table 3-2: Tool Requirements for Planned Maintenance and Checkout Procedures

Procedure Name	Service Tools Needed (QTY)
Visual Inspection	None
Cleaning (Thermal Print Head)	Methanol or Isopropyl Alcohol, Cotton Swab, Sterile Gauze
Transducers Checks	None
Functional Checks	PS320 Fetal Fluke® Simulator (2), Fluke® Mechanical Fetal Heart (1), Ultrasound Transducers(2), TOCO Transducer (1), Y Adapter Cable (1), Ultrasound Gel
NIBP Calibration Check	Adult Cuff (1), 3" Cylinder (1), Standard 12-foot NIBP hose (1), External Manometer (1) capable of reading to 350mmHg (46.7 kPa), Hand Pump Bulb (1)
Electrical Safety Tests	Electrical Safety Analyzer (1), Multimeter (1), MECG Cable (1), IUP Transducer (1), SpO_2 Sensor (1), Ultrasound Transducer (1), some Aluminum Foil

3.3 Maintenance and Checkout Procedures

3.3.1 Visual Inspection

1. Unplug the monitor power cord from the power outlet and disconnect it from the monitor.
2. Examine the power cord for any signs of damage. Replace the power cord if damage is evident.
3. Confirm the power cord is secured to the monitor with the power cord retainer.
4. Inspect the overall unit (top cover, front bezel, screen display, connectors, front panel buttons) for any damaged (cracked or broken) or missing parts. If any part is damaged or missing, replace it.
5. Inspect the unit for any missing labels. Make sure the labels are attached in the proper locations. For a list of labels, refer to section 7.2. For the proper location of each label, refer to Figure 7-4.

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3.3.2 Cleaning (Thermal Print Head)

NOTE: This section only includes the cleaning procedures to be performed by the service personnel. For a complete list of general cleaning procedures to be performed by the operator, refer to the Corometrics™ 250cx series Operator's Manual.

1. Confirm the monitor is turned off and the power cord is unplugged from the power outlet.

2. Use cotton swabs and methanol or isopropyl alcohol to clean the thermal print head heater elements and remove any accumulated paper dust.

NOTE: Do not touch the heater head with bare hands.

CAUTION:
Allow the cleaned elements to air dry completely prior to putting the unit back into use.

3.3.3 Transducer Checks

This section provides instructions to confirm the operational and functional performance of the transducers.

3.3.3.1 Ultrasound Transducer Checks

NOTE: Always use GE-approved transducers only.

1. Visually inspect the transducer case, the cable, the strain relief, and the connector pins for any signs of damage. Replace the transducer if damage is evident.

2. Turn the monitor on and connect the ultrasound transducer to either US or US2 input connector of the monitor unit and confirm that:

   a. The FHR1 value shows three steady dashes "– – –."

   b. The FHR1 mode shows *US*.

   c. The recorder prints *US* on the center margin of the strip chart paper after approximately 20 seconds.

3. Hold the ultrasound transducer in your hand with the transducer front facing the palm of your hand and use your other hand to gently press and depress the back of the transducer rhythmically while maintaining a steady rate. Confirm the following:

   a. The FHR1 value on the monitor follows the input rate.

   b. The recorder follows the input rate.

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c. The FHR1 heartbeat indicator (♥) flashes for each input.

d. Ultrasound audio is generated from the speaker on the rear side of the monitor.

3.3.3.2 TOCO Transducer Checks

NOTE: Always use GE-approved transducers only.

1. Visually inspect the transducer case (especially on the diaphragm located on the bottom of the transducer), the cable, the strain relief, and the connector pins for any signs of damage. Replace the transducer if damage is evident.

2. Turn the monitor on and connect the TOCO transducer to UA input connector of the monitor.

3. Use the Trim Knob Control of the monitor to access the *Install Options Screen 2* and note the Default TOCO Reference setting. Exit the service mode by selecting *Restart* at the bottom of the screen.

4. Momentarily depress the UA Reference Button of the monitor and confirm that:

   a. The UA value shows the default setting.

   b. The UA mode shows *TOCO*.

   c. The recorder prints *TOCO* on the strip chart paper.

5. Apply gentle pressure to the TOCO transducer diaphragm and confirm that the UA value responds to the pressure input. Increasing force should produce an increasing value and vice versa.

3.3.4 Functional Checks

This section provides instructions to confirm the operational and functional performance of the monitor unit.

NOTE: Always use GE-approved transducers only.

3.3.4.1 Indicators, Display, and Recorder Checks

1. Make sure that all transducers are disconnected from the front panel of the unit and the strip chart is loaded into the recorder.

2. Turn the unit power on. Confirm that the unit generates two tones from the rear panel speaker and the Power Indicator (green light) illuminates.

3. Confirm that the monitor display is on and it is showing the *General* screen.

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4. If present, connect the external display to the monitor unit (J112 connector) and confirm the external display mimic the monitor display content.

5. Turn the recorder on and depress the Mark Button on the front panel and verify that an event mark (↑) is printed on the lowest portion of the HR scale on the recorder paper.

6. Use the Trim Knob Control to access the *General Setup* screen and take a note of the value set for paper speed.

7. Depress the Record Button and confirm the following:

    a. The yellow indicator next to the button illuminates continuously.

    b. The recorder paper advances at a rate equal to the paper speed value in *General Setup* screen.

    c. The recorder prints the correct time and date information on the strip chart paper.

    d. The recorder prints the messages *CARDIO INOP* and *UA INOP*.

    e. The recorder prints the paper speed value, 1 cm/min or 3 cm/min.

8. Depress and hold the Paper Advance Button on the front panel and verify that the recorder paper advances at a rate of 40 cm/min by measuring.

9. Release the Paper Advance Button and verify that the recorder prints the paper speed value.

10. Access the *Install Options Screen 1* screen again to change the paper speed and verify that the recorder prints the correct paper speed value and also advances at the correct speed.

11. Make sure to set the paper speed in the *General Setup* screen in accordance with hospital or local requirements.

WARNING:
Incorrect paper speed setting results in inaccurate waveform prints on the strip chart paper.

3.3.4.2 Self-Test Routine

1. Make sure GE-approved strip chart paper is loaded into the unit recorder.

2. Turn the unit power on.

3. Depress the Test Button and confirm the following:

    a. Display Test: All display pixels extinguish for one second and then illuminate for one second. A green horizontal line moves down on a red background followed by a blue vertical line moving from left to right.

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b. Lamp Test: The yellow Record Indicator illuminates.

c. Recorder Test: The recorder prints the message *TEST: ARE ALL DOTS PRINTED?* followed by two vertical lines and four horizontal lines. The two vertical lines should appear continuous and indicate a fully functional print head. The four horizontal lines align with the heart rate and uterine activity scales, i.e., 30 and 240 BPM or 50 and 210 BPM, and 0 and 100 mmHg (0.0 and 13.3 kPa).

NOTE: If the simulated fetal heart rate trends do not appear in the correct positions on the strip chart recorder paper, ensure the monitor paper scale (30-240 bpm or 50-210 bpm) setting matches the type of paper being used, i.e., 30 bpm/cm or 20 bpm/cm (See Scaling in section E.2).

WARNING:
Incorrect paper scaling setting (mismatch between the paper scaling and type of paper used) results in invalid waveform prints on the strip chart paper.

d. Counting Test: After the recorder test, the display returns to the *General* screen. The software generates a 120 bpm rate in the FHR1 area, a 180 bpm rate in the *FHR2* area, and shows 50 mmHg in UA area and all mode titles display *Test*.

NOTE: To stop a self-test routine that is in progress, depress the Test Button or open the recorder door.

NOTE: The recorder returns to its original on, off, or maternal-only mode state before the Test Button was depressed.

3.3.4.3 RS-232C Loopback Check

1. Turn on the monitor and use the Trim Knob Control to enter into service mode and access the *Communication Setup* screen.

2. Insert a loopback test connector into each RS-232C communication port (J109, J110, and J111) on the rear side of the unit (See Figure 1-6).

NOTE: If a loopback test connector is not available, for each communication port manually bridge pin 2 (RXD) and pin 5 (TXD) together (See Figure 1-7).

3. For each communication port, set the mode field on the *Communications Setup* screen to *Loopback* and then press the Trim Knob Control to select it. Notice that the word *OFF* displays to the right of the mode.

4. Confirm that the status *Loopback OK* displays after a few seconds (See Figure E-4*)*.

NOTE: *OK* indicates that the test has passed and *OFF* indicates test failure. Do not use the communication port that fails the test. Contact service for repair.

5. Exit the *Communication Setup* screen and select *Restart* in the *Install Options Screen 1* screen to reboot the monitor.

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3.3.4.4 Alarms Check

NOTE: The instructions in this procedure are based on the use of Fluke® PS320 simulator. Refer to Appendix G for Corometrics™ 325 simulator use instructions.

1. Make sure the monitor unit and the PS320 simulator are both turned off.

2. Connect a Y adapter cable (GE Part number: 1442AAO) to the monitor and then connect the 3-Lead MECG cable (orderable through GE part number: 2025177-055) to the MECG connector of the Y adapter and the left panel terminals of the PS320 simulator as per below connection diagram (See Figure D-1*)*:

3-Lead ECG Cable Terminal Name		PS320 Simulator - Left Panel Terminal
Left Arm (LA)	shall be connected to	Fet/Mat
Left Leg (LL)	shall be connected to	Maternal
Right Arm (RA)	shall be connected to	Reference

3. Turn on the PS320 simulator and the monitor unit.

4. Use the Trim Knob Control of the monitor unit to select *MECG* to access the *MHR/P Setup* screen.

5. Set the MHR/P source to *MECG*.

6. Set HR/PR Trace to *On*.

7. Set the MHR/P high alarm limit value to *120 BPM*.

8. Set the MHR/P low alarm limit value to *80 BPM*.

9. Set the Alarm Volume to a level you can easily hear.

10. Exit the *MHR/P* Setup screen.

11. Use the PS320 simulator front panel to set the Maternal ECG parameters, MAT.(Rate) to 100 BPM and Amplitude to 0.5mV.

NOTE: For PS320 simulator setup information, see Appendix D.

12. Set the MECG parameter on PS320 to 140 BPM as indicated on the monitor and confirm that:

    a. An audio alarm (alternating high/low tones) is emitted from the rear panel speaker.

    b. The MECG value flashes.

13. Depress the Alarm Silence Button on the monitor front panel and confirm that:

    a. The audio alarm stops.

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b. The *ALARM SILENCE X:XX* message box appears on the screen and a countdown is started.

14. Wait for the user-specified re-alarm time to end and confirm that the audio alarm is once again generated from the rear panel speaker.

15. Set the MECG parameter on PS320 to 120 BPM as indicated on the monitor and confirm that:

    a. The audio alarm stops.

    b. The MECG value no longer flashes.

    c. After 10 seconds, the two above conditions are still true.

16. Set the MECG parameter on PS320 to 80 BPM. Confirm that no audio alarm is generated from the rear panel speaker.

17. Decrease the MECG rate to 60 BPM and confirm that:

    a. The audio alarm is generated from the rear panel speaker.

    b. The MECG value flashes.

18. Depress the Alarm Silence Button on monitor front panel and confirm that:

    a. The audio alarm stops.

    b. The MECG value continues flashing.

    c. The message *ALARM SILENCE X:XX* appears on the screen and a countdown is started.

19. Wait for the user-specified re-alarm time to end and confirm that the audio alarm is once again generated from the rear panel speaker.

20. Set the MECG parameter on PS320 to 80 BPM as indicated on the monitor and confirm that:

    a. The audio alarm stops.

    b. The MECG value no longer flashes.

    c. After 10 seconds, the two above conditions are still true.

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3.3.4.5 $MSpO_2$ Check

1. Use the Trim Knob Control on the monitor front panel to select *$MSpO_2$* on the *General screen* to access the *$MSpO_2$ Setup* screen and configure as follows:

   a. For Nellcor Models: Set Response Time to *Fast*, Print Interval to *2 minutes*, and % O_2 Trace to *On*.

   b. For Masimo Models: Set Sensitivity to *Normal*, Averaging to *8*, Print Interval to *2 minutes*, and % O_2 Trace to *On*

2. Access the *Install Options Screen 1* and set the SpO_2 Scale to *Auto*.

3. Set Default Settings to *Hospital* in *Install Options Screen 2* and then select Store Current to Hospital to save the settings. Exit the service mode by selecting *Restart* at the bottom of the screen.

4. Attach an SpO_2 sensor to your finger and connect it to the monitor and allow the monitor a few seconds to obtain a steady reading.

5. Select *Pulse/MECG* to enter *MHR/P Setup* screen and change MHR/P Source to *$MSpO_2$* and HR/PR Trace to *On* and then exit back to *General* screen.

6. Use Trim Knob Control to set the waveform softkey (on the bottom of *General* screen) to *$MSpO_2$*.

7. Turn on the recorder and allow data to collect for at least five minutes and confirm that:

   a. The correct waveform appears on the display.

   b. The $MSpO_2$ shows a value on the display.

   c. The $MSpO_2$ pulse amplitude indicator shows a fluctuating bar graph.

   d. The MHR/P display mode shows *Pulse*.

   e. The MHR/P displays a value.

   f. The MHR/P trend plots in the top grid with the above value.

   g. The $MSpO_2$ scale grid marks stamp on the paper.

   h. The message *$MSpO_2$%* is printed in the annotation line on the strip chart paper.

   i. A diamond symbol ◊ (with $MSpO_2$ and MHR/P vital signs) is printed in the annotation area on the strip chart paper at 2-minute intervals.

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3.3.4.6 MECG Input Check

NOTE: The instructions in this procedure are based on the use of Fluke® PS320 simulator. Refer to Appendix G for Corometrics™ 325 simulator use instructions.

1. Make sure the monitor unit and the PS320 simulator are both turned off.

2. Connect a Y adapter cable (GE Part number: 1442AAO) to the monitor and then connect the 3-Lead MECG cable (orderable through GE part number: 2025177-055) to the MECG connector of the Y adapter and the left panel terminals of the PS320 simulator as per below connection diagram:

3-Lead ECG Cable Terminal Name		PS320 Simulator - Left Panel Terminal
Left Arm (LA)	shall be connected to	Fet/Mat
Left Leg (LL)	shall be connected to	Maternal
Right Arm (RA)	shall be connected to	Reference

3. Turn on the PS320 simulator and the monitor.

4. Use the PS320 simulator front panel to set the Maternal ECG parameters, MAT.(Rate) to 60 BPM and Amplitude to 0.5mV.

NOTE: For PS320 simulator setup information, see Appendix D .

5. Verify that the monitor display shows a value of 60 BPM and confirm that:

   a. The MHR/P mode shows *MECG*.

   b. The MHR heartbeat indicator (♥) flashes at a rate of 60 times per minute (1 per second).

6. Change the MAT. rate to 80 BPM on the PS320 simulator. Confirm the following on the monitor display and the recorder:

   a. The MHR Value shows *80 ± 1*.

   b. The MHR heartbeat indicator (♥) flashes at a rate of 80 times per minute.

   c. The ECG “beep” volume is generated from the rear panel speaker.

   d. The volume can be adjusted on the *MHR/P Setup* screen.

   e. The recorder prints a continuous line at 80 BPM on the top grid of the strip chart paper. (Set HR/PR Trace to *On* in the *MHR/P Setup screen*.)

7. Repeat step 6 for each of the following rates: 100, 120, 140 and 160 BPM.

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3.3.4.7 FECG Input Check

NOTE: The instructions in this procedure are based on the use of Fluke® PS320 simulator. Refer to Appendix G for Corometrics™ 325 simulator use instructions.

1. Make sure the monitor unit and the PS320 simulator are both turned off.

2. Connect a Y adapter cable (GE Part number: 1442AAO) to the monitor and then connect the 3-Lead FECG cable (orderable through GE part number: 2025177-055) to the FECG connector of the Y adapter and the left panel terminals of the PS320 simulator as per below connection diagram:

3-Lead ECG Cable Terminal Name		PS320 Simulator - Left Panel Terminal
Left Leg (LL)	shall be connected to	Fet/Mat
Right Arm (RA)	shall be connected to	Fetal
Left Arm (LA)	shall be connected to	Reference

3. Turn on the PS320 simulator and the monitor unit.

4. Use the PS320 simulator front panel to set the Fetal ECG parameters, Fetal(Rate) to 60 BPM and Amplitude to 0.5mV.

NOTE: For PS320 simulator setup information, see Appendix D .

5. Look at the monitor display until the monitor displays a value of 60 BPM and confirm that:

   a. The MHR/P mode shows *MECG*.

   b. The MHR heartbeat indicator (♥) flashes at a rate of 60 times per minute (1 per second).

6. Change the Fetal rate to 80BPM in the PS320 simulator. Confirm the following on the monitor display and the recorder:

   a. The MHR Value shows *80 ± 1*.

   b. The MHR heartbeat indicator (♥) flashes at a rate of 80 times per minute.

   c. The ECG “beep” volume is generated from the rear panel speaker. The volume can be adjusted on the *MHR/P Setup* screen.

   d. The recorder prints a continuous line at 80 BPM on the top grid of the strip chart paper. (Set HR/PR Trace to *On* in the *MHR/P Setup screen*.)

7. Repeat step 6 for each of the following rates: 100, 120, 140 and 160 BPM.

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3.3.4.8 Ultrasound Input Check

NOTE: The instructions in this procedure are based on the use of Fluke® PS320 simulator. Refer to Appendix G for Corometrics™ 325 simulator use instructions.

1. Make sure the monitor and the PS320 simulator are both turned off.

2. Connect a GE-approved ultrasound transducer to the US input connector of the monitor and connect the Fluke® mechanical fetal heart (MFH-1) to the US1 port of the PS320 simulator.

3. Place the ultrasound transducer face up on a flat surface and coat the face with an appropriate ultrasound conductive gel.

4. Turn on the PS320 simulator and the monitor unit.

5. Place the simulation window of the mechanical fetal heart over the ultrasound transducer and then use the PS320 simulator front panel to set the ultrasound (Fetal Heart Rate) parameters Fetal (Rate) to 120 BPM and Amplitude to 50µV.

NOTE: For PS320 simulator setup information, see Appendix D .

6. Make sure the monitor recorder is on. Depress the Record Button on the monitor front panel to turn the recorder on if necessary.

7. Confirm the following on the monitor display and the recorder:

    a. The FHR1 mode shows *US*.

    b. The FHR1 value shows *120 ± 1*.

    c. The FHR1 heartbeat indicator (♥) flashes at a rate of 120 times per minute.

    d. The ultrasound audio is generated from the rear panel speaker and the volume can be adjusted using the Volume (Increase/Decrease) Buttons.

    e. The recorder prints a continuous line at 120 BPM on the top grid of the strip chart paper.

    f. The recorder prints *US* on the center margin of the strip chart paper after approximately 20 seconds.

8. Increase the US value from 120 BPM baseline to 150 BPM in the PS320 simulator. Confirm the following on the monitor display and the recorder:

    a. The FHR1 value immediately shows *150 ± 1*.

    b. The recorder prints a continuous line at 150 BPM on the top grid of the strip chart paper.

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9. Decrease the US value from 120 BPM baseline to 90 BPM in the PS320 simulator. Confirm the following on the monitor display and the recorder:

    a. The FHR1 value immediately shows *90 ± 1*.

    b. The recorder prints at the last input rate for an additional 3 seconds before blanking the heart rate data and printing a continuous line at 90 BPM on the top grid of the strip chart paper

10. Set the US value to each of the following rates in PS320 simulator: 60, 90, 120, 150, 180, and 210 BPM and confirm that:

    a. The FHR1 value reflects the rate set in the PS320 simulator with a tolerance of ± 1 BPM .

    b. The FHR1 heartbeat indicator (♥) flashes at the rate set in the PS320 simulator.

    c. The ultrasound audio is generated from the rear panel speaker.

    d. The recorder prints a continuous line at the set value ± 3 BPM on the top grid of the strip chart paper.

11. Turn the monitor and the PS320 simulator off. Disconnect the ultrasound transducer from the monitor and connect it to the second US connector (US2) on the monitor unit and then turn the monitor unit and PS320 simulator on. Repeat steps 6 to 9 using the second ultrasound channel (The mode will show US2).

12. Disconnect the ultrasound transducer from the monitor unit. Confirm the following on the monitor display and the recorder:

    a. The FHR1 value is blank and the mode shows *INOP*.

    b. The recorder stops printing the fetal heart rate trace.

    c. The recorder prints *CARDIO INOP* on the center margin of the strip chart paper after approximately 20 seconds.

3.3.4.9 Uterine Activity Input Check

NOTE: The instructions in this procedure are based on the use of Fluke® PS320 simulator. Refer to Appendix G for Corometrics™ 325 simulator use instructions.

1. Make sure the monitor and the PS320 simulator are both turned off.

2. Connect the TOCO cable (Fluke® Part number: 2462519) to the UA input connector of monitor unit and the TOCO connector of the PS320 simulator.

3. Turn on the PS320 simulator and the monitor unit.

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4. Use the Trim Knob Control of the monitor to go to Service Mode and access the *Install Options Screen 2* and set Pressure units to *mmHg*.

5. Take a note of the Default TOCO Reference value.

NOTE: The monitor is shipped from the factory with the Default TOCO Reference value set at 10 mmHg (1.3 kPa). However, your monitor may have been custom configured.

6. Exit the Service Mode by selecting *Restart* at the bottom of the screen.

7. Make sure the monitor recorder is on. Depress the Record Button on the monitor front panel to turn the recorder on if necessary.

8. Briefly press the UA Reference Button on the monitor. Confirm the following on the monitor display and the recorder:

    a. The UA mode shows *TOCO*.

    b. The UA value reflects the value of Default TOCO Reference.

    c. The recorder prints a continuous line at the default value on the uterine activity channel of the strip chart paper.

    d. The recorder prints *UA REF* on the strip chart paper.

9. Press and hold the UA Reference Button on the monitor to cycle through the available selections for UA reference: 5,10, 15, 20, or 25 relative units in mmHg mode. Confirm that the correct UA value is displayed on the monitor and that the recorder prints a continuous line at the corresponding value on the uterine activity channel of the strip chart paper.

10. Set the TOCO amplitude to 5µV and TOCO Level at each of the level settings: 0, 20, 40, 60, 80 and 100 relative units in the PS320 simulator. Confirm that the correct UA value is displayed on the monitor and that the recorder prints a continuous line at the corresponding value on the heart rate channel of the strip chart paper.

NOTE: For PS320 simulator setup information, see Appendix D.

11. Disconnect the TOCO cable from the monitor and simulator. Connect the IUP cable (Fluke® Part Number: 2462469) from TOCO connector in PS320 Simulator to the UA connector of the monitor.

12. Set the TOCO Level to 0 mmHg/kPa. Depress the UA Reference Button on the monitor. Confirm on the monitor and recorder display that:

    a. The UA value shows *0*.

    b. The UA mode shows *IUP*.

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c. The recorder prints a continuous line at 0 mmHg on the uterine activity channel of the strip chart paper.

d. The recorder prints *UA REF* on the strip chart paper.

13. Set the simulator TOCO amplitude to 5µV and TOCO Level at each of the level settings: 0, 20, 40, 60, 80 and 100 mmHg. Look at the monitor display/recorder and confirm that the UA value is displayed accordingly and that the recorder prints a continuous line at the corresponding value on the uterine activity channel of the strip chart paper.

14. Disconnect the IUP cable from the UA input connector on the front panel of the monitor. Confirm the following on the monitor display and the recorder:

a. The UA value is blank and the mode shows *INOP*.

b. The recorder stops printing the uterine activity trace.

c. The recorder prints *UA INOP* on the center margin of the strip chart paper after approximately 20 seconds.

3.3.5 Pattern Memory Check

NOTE: The instructions in this procedure are based on the use of Fluke® PS320 simulator. Refer to Appendix G for Corometrics™ 325 simulator use instructions.

1. Make sure the monitor and the PS320 simulator are both turned off.

2. Connect the FECG and TOCO cables (orderable through GE part number: 2025177-055 and Fluke® Part number: 2462519) to the corresponding connectors of the monitor and the PS320 simulator (See Appendix D).

3. Turn on the PS320 simulator and the monitor unit.

4. Use the PS320 simulator front panel to select FETAL PATTERNS by repeatedly pressing MAIN Button.

5. Select *TREND 1* from the Menu by pressing the SUB Button on the PS320 simulator and press ENTER after selecting the *TREND 1* pattern. The simulator starts to change the fetal heart rate and uterine activity values up and down.

NOTE: For PS320 simulator setup information, see Appendix D .

6. Make sure the monitor recorder is on. Depress the Record Button on the monitor unit front panel to turn the recorder on if necessary.

7. Confirm that the monitor recorder prints out a value equal to that displayed on the monitor for FHR and UA parameters.

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3.3.5.1 Dual Heart Rate Check (FECG/US Modes)

NOTE: The instructions in this procedure are based on the use of Fluke® PS320 simulator. Refer to Appendix G for Corometrics™ 325 simulator use instructions.

NOTE: Two PS320 simulators are required to perform this check. One PS320 simulator is used for providing FECG signal and the other one is used for providing the ultrasound signal.

1. Make sure the monitor and the PS320 simulators are both turned off.

2. Connect a Y adapter cable (GE Part number: 1442AAO) to the monitor and then connect the 3-Lead FECG cable (orderable through GE part number: 2025177-055) to the FECG connector of the Y adapter and the left panel terminals of the PS320 simulator as per below connection diagram:

3-Lead ECG Cable Terminal Name		PS320 Simulator - Left Panel Terminal
Left Leg (LL)	shall be connected to	Fet/Mat
Right Arm (RA)	shall be connected to	Fetal
Left Arm (LA)	shall be connected to	Reference

3. Connect a GE-approved ultrasound transducer to the US input connector of the monitor and connect the Fluke® mechanical fetal heart (MFH-1) to the US1 port of the second PS320 simulator.

4. Turn on the two PS320 simulators and the monitor.

5. Use the first PS320 simulator front panel to set the Fetal ECG parameters Fetal (Rate) to 120 BPM and Amplitude to 50µV.

NOTE: For PS320 simulator setup information, see Appendix D .

6. Place the simulation window of the mechanical fetal heart connected to second PS320 over the ultrasound transducer and then use the PS320 simulator front panel to set the ultrasound (US1 Port) parameters Fetal (Rate) to 150 BPM and Amplitude to 50µV.

7. Make sure the monitor recorder is on. Depress the Record Button on the monitor front panel to turn the recorder on if necessary.

8. Confirm the following on the monitor display and the recorder:

   a. The FHR1 mode shows *FECG*.

   b. The FHR1 value shows *120 ± 1*.

   c. The FHR1 heartbeat indicator (♥) flashes at a rate of 120 times per minute.

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d. The FHR2 heartbeat indicator (♥) flashes at a rate of 150 times per minute.

e. The FHR2 mode shows *US*.

f. The recorder prints the messages *FECG* and *US* on the center margin of the strip chart paper.

g. The recorder prints a continuous plain black line on the 120 BPM mark on the heart rate channel of the strip chart paper.

h. The recorder prints a bold black ramp trace on the 150 BPM mark on the heart rate channel of the strip chart paper.

3.3.5.2 Dual Heart Rate Check (Dual Ultrasound Modes)

NOTE: Two ultrasound transducers are required to generate fetal heart rate signals to perform this check.

NOTE: This check can also be performed using two PS320 simulators. Do not perform this check using one PS320 simulator and one ultrasound transducer.

1. Make sure the monitor unit is turned off.

2. Connect one ultrasound transducer to the US input connector and the other ultrasound transducer to the US2 input connector of the monitor unit.

3. Turn on the monitor unit.

4. Make sure the monitor recorder is on. Depress the Record Button on the monitor unit front panel to turn the recorder on if necessary.

5. Confirm the following on the monitor display and the recorder:

   a. The FHR1 mode shows *US*.

   b. The FHR2 mode shows *US2*.

   c. The FHR1 value shows three steady dashes "– – –."

   d. The FHR2 value shows three steady dashes "– – –."

   e. The recorder prints *US* and *US2* on the center margin of the strip chart paper.

6. Hold the ultrasound transducer connected to US input in your hand with the transducer front facing the palm of your hand and use your other hand to gently press and depress the back of the transducer rhythmically while maintaining a steady rate. Confirm the following:

   a. The FHR1 value responds to the rubbing.

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b. The FHR1 heartbeat indicator (♥) responds to the input.

c. The recorder prints the heart rate tracing corresponding to the rate and the trace is plain black.

7. Hold the ultrasound transducer connected to US2 input in your hand with the transducer front facing the palm of your hand and use your other hand to gently press and depress the back of the transducer rhythmically while maintaining a steady rate. Confirm the following:

   a. The FHR2 value responds to the rubbing.

   b. The FHR2 heartbeat indicator (♥) responds to the input.

   c. The recorder prints the heart rate tracing corresponding to the rate and the trace is bold black.

3.3.6 NIBP Calibration Check

This procedure provides instruction to verify the accuracy of the NIBP circuitry, perform calibration if necessary, and check the NIBP pneumatic circuit plumbing for leaks. Refer to section 4.4.1 for detailed information.

3.3.7 Electrical Safety Tests

This section provides instructions to check if potential electrical health hazards to the patient or the operator of the monitor unit exist.

Use an electrical safety analyzer and follow the operating instructions supplied by the manufacturer of the safety analyzer to set up and perform the electrical safety tests.

NOTE: For reliable leakage current checks, perform the Ground Resistance Check first.

3.3.7.1 Power Outlet Check

This procedure checks the condition of the power outlet (wall outlet) from which the monitor gets power to ensure correct results from leakage tests. Use a multimeter to ensure the power outlet is wired properly. If other than normal polarity and ground is indicated, corrective action must be taken before proceeding. The results of the following tests will be meaningless unless a properly wired power outlet is used.

3.3.7.2 Ground Resistance Check

Perform this check on the monitor unit only, with no other equipment (peripherals) attached.

1. Connect the monitor power cord to the safety analyzer.

2. Verify that the AC power cord of the safety analyzer is plugged into an appropriate wall outlet.

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3. Turn on the safety analyzer and set it to measure the ground resistance.

4. Measure the resistance between the ground (earth) terminal of the Power Inlet Module and the Equipotential Lug on the rear side of the monitor unit. The resistances shall be 100mΩ or less.

3.3.7.3 Ground (Earth) Leakage Current and Enclosure Leakage Current Checks

Perform this check on the monitor unit only, with no other equipment (peripherals) attached.

1. Connect the monitor power cord to the safety analyzer.

2. Verify that the AC power cord of the safety analyzer is plugged into an appropriate wall outlet.

3. Turn on the safety analyzer and set it to measure the ground leakage current.

4. Turn on the monitor unit.

5. In normal conditions and in all possible operating modes, the ground leakage current shall be 300 µA or less.

6. If required by local ordinances, in single-fault conditions and in all possible operating modes, the ground leakage current shall be 500 µA or less.

7. Set the safety analyzer to measure the enclosure (chassis) leakage current (Use the Equipotential Lug in the rear side of the monitor for the chassis connection of the safety analyzer).

8. In normal conditions and in all possible operating modes, the enclosure leakage current shall be 100 µA or less.

9. If required by local ordinances, in single-fault conditions and in all possible operating modes, the enclosure leakage current shall be 300 µA or less.

3.3.7.4 Patient-to-Ground (Patient Source) and Patient-to-Line (Patient Sink) Leakage Current Checks

Perform this check on the monitor unit only, with no other equipment (peripherals) attached. Table 3-1 lists the maximum allowable patient (source/sink) leakage currents for different applied parts.

1. Connect an ECG test body (e.g. ECG cable with all its leads shorted together) to the ECG input of the monitor.

2. Connect the monitor power cord to the safety analyzer.

3. Verify that the AC power cord of the safety analyzer is plugged into an appropriate wall outlet.

4. Attach the External clamp of the safety analyzer to the test body.

5. Turn on the safety analyzer and configure it to measure the patient (source/sink) leakage currents.

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6. Turn on the monitor unit.

7. In normal conditions and in all possible operating modes, the patient leakage currents shall be 10 µA or less.

8. If required by local ordinances, in single-fault conditions and in all possible operating modes, the patient (source/sink) leakage currents shall be 50 µA or less.

9. Disconnect the ECG test body from the monitor. Connect an US test body (e.g. Ultrasound transducer wrapped in aluminum foil) to the US input of the monitor and repeat steps 2 to 5. The patient (source/sink) leakage currents shall be 100 µA or less in normal conditions (all possible operating modes) and 500 µA or less in single-fault conditions (all possible operating modes).

10. Disconnect the US test body from the US input and connect it to the US2 input of the monitor and repeat steps 2 to 5. The patient (source/sink) leakage currents shall be 100 µA or less in normal conditions (all possible operating modes) and 500 µA or less in single-fault conditions (all possible operating modes).

11. Disconnect the US test body from the US2 input. Connect an SpO_2 test body (e.g. SpO_2 sensor wrapped in aluminum foil) to the $MSpO_2$ input of the monitor and repeat steps 2 to 5. The patient leakage currents shall be 100 µA or less in normal conditions and 500 µA or less in single-fault conditions.

12. Disconnect the SpO_2 test body from the monitor. Connect an IUP or TOCO test body (e.g. IUP or TOCO transducer wrapped in aluminum foil) to the UA input of the monitor and repeat steps 2 to 5. The patient leakage currents shall be 100 µA or less in normal conditions and 500 µA or less in single-fault conditions.

Table 3-3: Maximum allowable patient leakage currents for applied parts of Coro250cx series monitor

Applied Part	Part Type (per IEC 60601-1)	Maximum Allowable Leakage Current (a.c.) (µA)	
		Normal condition	Single-fault condition
FECG	CF	10	50
MECG	Defib-CF	10	50
US1, US2	BF	100	500
SpO_2	BF	100	500
UA	BF	100	500
NIBP	Defib-BF	100	500
Temperature	BF	100	500
Fetal Acoustic Stimulator	BF	100	500

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Chapter 4: Calibration

This chapter includes calibration procedures required for Corometrics™ 250cx series monitor repair, or maintenance. These procedures must be performed by authorized service personnel.

Each Corometrics™ 250cx Series monitor is calibrated in the factory prior to shipment to the customer and so no calibration is required upon the installation of the monitor unit.

4.1 Calibration Schedule

Table 4-1 lists the calibration procedures, specifies when and how often each procedure should be performed, and provides the approximate time that it takes to perform each procedure.

For good care and maintenance of the Corometrics™ 250cx series product, perform calibration procedures at specific time intervals.

Table 4-1: Calibration Procedures Schedule

Procedure Name	Approximate Time	To Be Performed as Planned Maintenance	To Be Performed as Checkout after any service
NIBP Calibration Check	8 minutes	Annually	As needed*
Recorder Photosensors Check	5 minutes	As needed	As needed**
Recorder Calibration (offsets) Check	2 minutes	Annually	As needed**

*NIBP calibration check shall be performed after repair or replacement procedures related to NIBP subsystem of the monitor.

** Recorder photosensors check and calibration (offsets) check shall be performed after repair or replacement procedures related to recorder assembly of the monitor.

WARNING:
Do not service the Corometrics™ 250cx series unit while it is in clinical use.

CAUTION:
Table 4-1 shows the minimum frequencies required for maintenance. Always follow hospital and local regulations for required frequencies.

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4.2 Environmental Requirements

The system shall be installed, serviced, and operated within the environmental conditions described in section A.1.

4.3 Tool Requirements

The following table lists the service tools required to perform the calibration procedures:

Table 4-2: Tool Requirements for Calibration Procedures

Procedure Name	Service Tools Needed (QTY)
NIBP Calibration Check	Adult Cuff (1), 3" rigid Cylinder (1), Standard 12-foot NIBP hose (1), External Manometer (1), capable of reading to 350mmHg (46.7 kPa), Hand Pump Bulb (1)
Recorder Photosensors Check	Multimeter (1)
Recorder Calibration (offsets) Check	Standard service tools

NOTE: Do not use a DNI CuffLink to perform the calibration procedures.

4.4 Calibration Procedures

4.4.1 NIBP Calibration Check

This section provides instruction to verify the accuracy of the NIBP circuitry, perform calibration if necessary, and check the NIBP pneumatic circuit plumbing for leaks. Any NIBP calibration check procedure consists of a sequence of sub-procedures:

a. Calibration Verification

b. Transducer Calibration

c. Overpressure Detection

d. System Leakage

The sequence starts with Calibration Verification. If Calibration Verification shows that the NIBP transducers are out of calibration then Transducer Calibration shall be performed. Perform Overpressure Detection and System Leakage only after NIBP transducers have been shown to be in calibration.

To set up the system and tools for calibration procedures (See Figure 4-1):

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1. Wrap an adult cuff around a 3” rigid cylinder.

2. Connect a standard 12-foot NIBP hose between the cuff and the monitor.

3. If hand inflation is needed, connect a hand pump bulb between the cuff and the NIBP hose.

4. Access the *NIBP Calibration* screen by navigating to *Install Screen Options 1* in the service mode and then selecting *Tests* softkey. Select *NIBP Cal* in the *Diagnostics Control* screen.

NOTE: The external manometer must read pressure in the same scale (mmHg or kPa) as the monitor. Settings can be changed on the monitor Pressure Units to match the unit setting on the manometer.

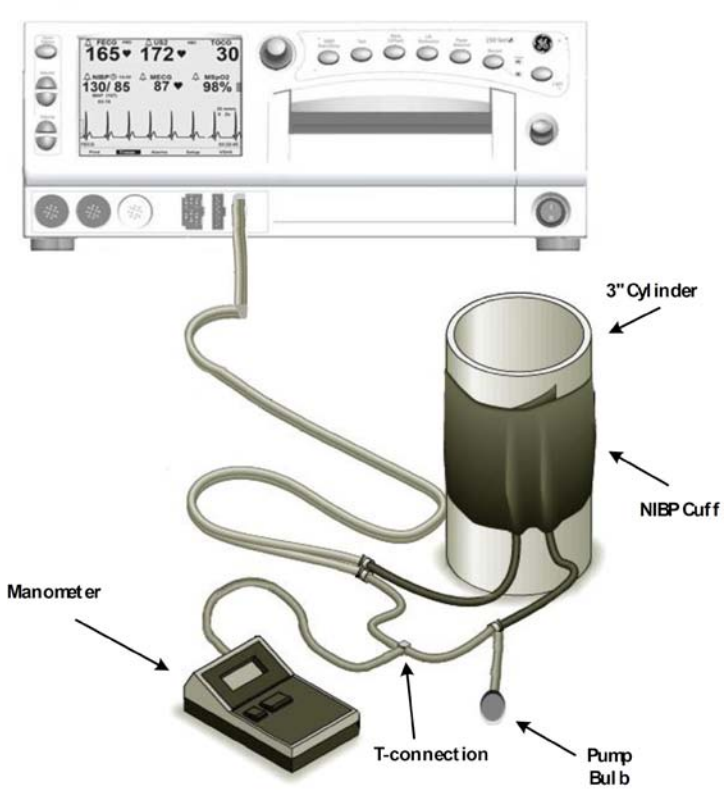

Figure 4-1 NIBP Calibration Check Setup

4.4.1.1 Calibration Verification

1. Use the Trim Knob Control to set Mode to *Verify* in the *NIBP Calibration* screen. The monitor will inflate the cuff to approximately 200 mmHg.

2. Confirm that the PT1 and PT2 pressure values shown on the monitor display are within the “pass” range of external manometer reading ± 2 mmHg (0.3 kPa) . If the pressure values are not within the “pass” range, perform the Transducer Calibration sub-procedure.

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NOTE: To stop Calibration Verification select *Done*, which appears after the *Verify* softkey has been pressed. The monitor will vent pressure to atmosphere and re-zero the transducers.

4.4.1.2 Transducer Calibration

1. Use the Trim Knob Control to set Mode to *Calibrate* in the *NIBP Calibration* screen. The monitor will inflate the cuff to approximately 200 mmHg.

2. Once the pressure has stabilized, use the Trim Knob Control to enter the pressure from the external manometer in the External field.

NOTE: Best accuracy is achieved if the system is given a short time to settle. Best accuracy is achieved if the system pressure is at or near 200 mmHg (26.7 kPa). The monitor will vent pressure to atmosphere and re-zero the transducers after Trim Knob Control is pressed to enter the pressure value in the External field.

3. Perform Calibration Verification and then repeat steps 1-3 if Calibration Verification fails.

4. Commit the new calibration factors by selecting *Store Calibration* in the *NIBP Calibration* screen.

NOTE: Between entering the external pressure and committing the new calibration factors the Exit menu item will display as *Exit – No Store* to indicate current calibration factors will be lost if Service Mode is exited prior to selecting *Store Calibration*.

NOTE: The menu item Store Calibration will only display after Calibration Verification has been performed during the Calibration procedure.

4.4.1.3 Overpressure Detection

1. Use the Trim Knob Control to set Mode to *OVP Test* in the *NIBP Calibration* screen. The monitor will close the valves.

2. Use the hand pump bulb to inflate the system until the monitor detects an overpressure condition. When approaching the overpressure trip point, inflate the system slowly.

NOTE: Upon detection of an overpressure condition, the monitor will vent pressure to the atmosphere and re-zero the transducers. The monitor displays the maximum detected pressure near the bottom of the *NIBP Calibration* screen.

3. If the overpressure condition occurs when the external manometer reading is outside of 300 - 330 mmHg (40.0 - 44.0 kPa) range, perform Calibration Verification and Transducer Calibration. Then repeat steps 1-2. Contact service if the overpressure condition still occurs outside of 300 - 330 mmHg (40.0 - 44.0 kPa) range.

4.4.1.4 System Leakage

1. Use the Trim Knob Control to set Mode to *Leak Test* in the *NIBP Calibration* screen.

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NOTE: Make sure you have the 12-foot hose and the cuff tightly wrapped around a rigid 3" cylinder. This air volume is required to properly test the leakage rate.

NOTE: To perform the leakage test, the monitor will inflate to approximately 200 mmHg (26.7 kPa), allow 45 second of settling time, then take two pressure readings (30 seconds apart) to calculate the system leakage rate, and eventually vent pressure to the atmosphere. The system leakage rate and PASS or FAIL result will be displayed on the screen.

2. Upon completion of the test, confirm that the monitor displays the leakage rate and *PASS* near the bottom of the *NIBP Calibration* screen.

NOTE: System leakage rate shall be no more than 6 mmHg (0.8 kPa) per minute. If the monitor has a leakage rate more than 6mmHg (0.8 kPa) per minute, inspect the external and internal pneumatic hoses, valves, connectors for loose connection and or leaks.

4.4.2 Recorder Photosensors Check

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

4.4.2.1 Paper-Low Photosensor Adjustment

1. Remove the top cover of the monitor as instructed in section 6.1.

2. Load the recorder with GE-approved strip chart paper. Make sure that there are no black squares showing.

3. Turn on the monitor unit.

4. Press the Record Button on the monitor front panel to turn on the recorder. Allow the paper to advance for a few seconds in order to tension the paper.

5. Turn off the recorder.

6. Set a multimeter to measure DC voltage and connect its positive lead to Pin 4 of J9 and the negative lead to Pin 2 of J9 on the recorder board.

7. Confirm that the multimeter reads a DC voltage of +150 ± 2 mVDC. Adjust R31 on the recorder board, if necessary, to set the voltage to be within the acceptable range.

NOTE: If you open and then close the recorder door, the DC voltage reading may vary 5–10 mV due to the loss of tension in the paper. This is acceptable and you do not need to re-adjust.

8. Open the recorder door and verify that the reading on the multimeter is greater than +4.75 VDC.

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9. To create a paper-low condition, re-load the paper so that black squares show on the surface (i.e., the last several sheets of a pack).

10. Turn on the recorder.

11. The value on the multimeter shall go up and down as the paper surface alternates between black and white. Verify that the maximum value is greater than or equal to 2.0 VDC.

12. Turn off the recorder.

4.4.2.2 Paper-Out Photosensor Adjustment

1. Remove the top cover of the monitor as instructed in section 6.1.

2. Load the recorder with GE-approved strip chart paper. Make sure that there are no black squares showing.

3. Turn on the monitor unit.

4. Press the Record Button on the monitor front panel to turn on the recorder. Allow the paper to advance for a few seconds in order to tension the paper.

5. Turn off the recorder.

6. Set a multimeter to measure DC voltage and connect its positive lead to Pin 3 of J9 and the negative lead to Pin 2 of J9 on the recorder board.

7. Confirm that the multimeter reads a DC voltage of +150 ± 2 mVDC. Adjust R29 on the recorder board, if necessary, to set the voltage to be within the acceptable range.

NOTE: If you open and then close the recorder door, the reading may vary 5–10 mV due to the loss of tension in the paper. This is acceptable and you do not need to re-adjust.

8. Open the recorder door and verify that the reading on the multimeter is greater than +4.75 VDC.

4.4.2.3 Paper-Load Photosensor Adjustment

1. Remove the top cover of the monitor as instructed in section 6.1.

2. Load the recorder with GE-approved strip chart paper. Make sure that there are no black squares showing and the recorder is loaded with at least nine sheets of strip chart paper.

3. Turn on the monitor unit.

4. Set a multimeter to measure DC voltage and connect its positive lead to Pin 6 of J9 and the negative lead to Pin 2 of J9 on the recorder board.

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5. Confirm that the multimeter reads a DC voltage of 190 ± 5 mVDC. Adjust R41 on the recorder board, if necessary, to set the voltage to be within the acceptable range.

4.4.3 Recorder Calibration (offsets) Check

1. Load the monitor recorder with GE-approved strip chart paper.

2. Turn the monitor on.

3. Use the Trim Knob Control to access the *Diagnostic Control* screen and set the Recorder Calibration into *On* and press the Trim Knob Control to select it. Run the test for at least 10 seconds.

4. Confirm that the first horizontal trace is printed 0.49" ± 0.002" from the right hand edge of the paper. If the trace does not fall within the specified offset range, perform the recorder vertical offset adjustment as instructed in section 5.11.1.

5. Confirm the recorder paper does not curls to one side and the vertical lines are printed with equal weight from one end to the other with no dots missing along the vertical trace. If not, perform the recorder horizontal offset adjustment as instructed in section 5.11.2.

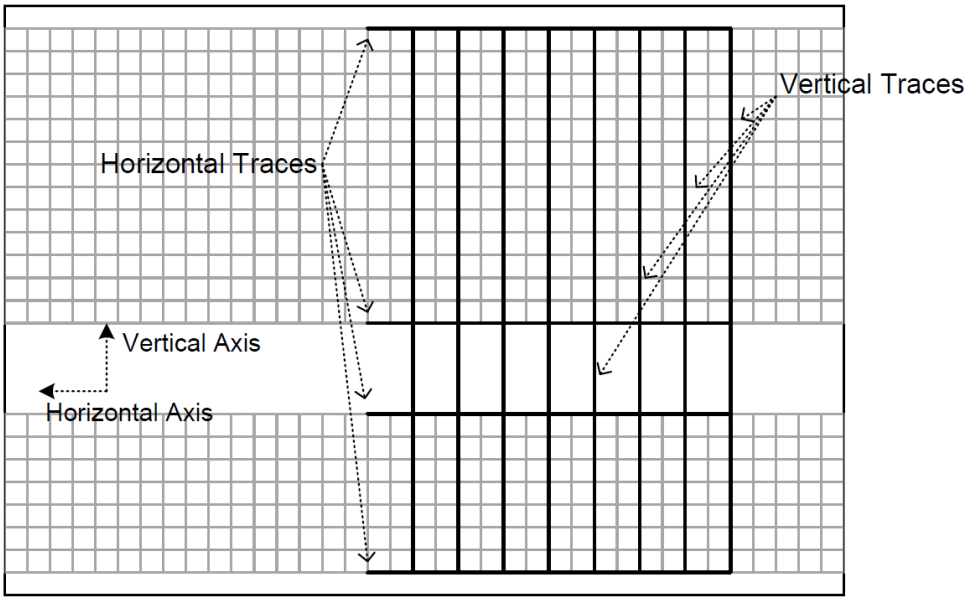

Figure 4-2 Horizontal and Vertical Traces on Strip Chart Paper

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Chapter 5: Diagnostics and Troubleshooting

This chapter lists some of the major symptoms of Corometrics™ 250cx Series monitors as well as the possible causes and solutions. For any necessary part replacements or adjustments, follow the instructions provided in See Chapter 6. Always read all the warnings, cautions, notes, and other information provided in the "Important Safety Information" section before starting any troubleshooting.

NOTE: For each symptom, the possible causes are listed in a certain sequence to provide a quick and effective troubleshooting guide. Therefore, investigate the possible causes of each symptom in order from top to bottom to find the root cause of the symptom.

NOTE: The ID column in troubleshooting tables is only created for the purpose of simplifying symptoms referencing throughout the manual.

5.1 General Troubleshooting Table

General Troubleshooting Table			
ID	**Symptom Description**	**Possible Causes**	**Actions and Solutions**
S1.1	No monitoring functions and Power Indicator does not illuminate when the monitor unit is turned on (Power Switch is placed in the On (I) position).	Power cord is not properly connected to the monitor unit or the power outlet.	Confirm that the power cord is plugged into the power outlet and securely connected to the monitor unit.
		No power at the outlet.	Confirm that power is available at the power outlet.
		Power cord is defective.	Disconnect the power cord from the unit and outlet and inspect for any damages. Replace the power cord if necessary.
		Fuses are open (defective) or missing.	Remove the top cover and check if the fuse is open. If yes, replace the power supply.

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General Troubleshooting Table			
ID	**Symptom Description**	**Possible Causes**	**Actions and Solutions**
S1.2	The monitor shows incorrect date and time.	Date and time are set incorrectly.	Access the General Setup screen to set the time and date.
		The timekeeping RAM chip (U30) on the main board is defective.	Replace the timekeeping RAM chip (See section 6.1).
		The main board is defective.	Replace the main board.
S1.3	The monitor does not generate any heartbeats or pulse sounds.	Audio volume is set too low.	Press the Volume buttons or access the respective setup screen(s) (*FECG*, *US*, *or US2*) to increase the volume.
		The transducer is not connected or is loosely connected.	Ensure that the transducer is securely attached to monitor and applied to the patient.
		Inadequate ultrasound gel is used.	Apply adequate ultrasound gel.
S1.4	When the monitor is turned on, the recorder does not function and the Record Indicator is off.	The recorder is off or out of paper.	Make sure GE-approved paper is installed in the recorder. Press the Record button.
		Paper-out photosensor is out of calibration.	Perform the recorder photosensors check (See section 4.4.2).
		Paper-out photosensor (on the left hand side of the recorder) is disconnected or defective.	Confirm the paper-out photosensor cable is connected properly to the recorder and the recorder board. Replace the photosensor if the symptom persists (See section 6.20).
S1.5	When the monitor is turned on, the recorder does not function and the Record Indicator is off and the message *PAPER INCORRECTLY LOADED, RELOAD WITH BLACK SQUARES DOWN* is shown in maternal waveform area.	Paper is loaded backwards in the recorder.	Re-install the paper in the recorder.

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General Troubleshooting Table			
ID	**Symptom Description**	**Possible Causes**	**Actions and Solutions**
S1.6	When the monitor is turned on, the recorder functions but the Record Indicator flashes on and off every second.	Paper supply in recorder is low or paper incorrectly loaded.	Install a new pack of GE-approved paper in the recorder.
		Paper-low photosensor is out of calibration.	Perform the recorder photosensors check (See section 4.4.2).
		Paper-low photosensor (on the right hand side of the recorder) is disconnected or defective.	Confirm the paper-low photosensor cable is connected properly to the recorder and the recorder board. Replace the photosensor if the symptom persists (See section 6.20).
S1.7	When the monitor is turned on, the recorder does not function and the Record Indicator is on.	The recorder stepper motor is defective.	Check if the recorder stepper motor does stepping. Replace the stepper motor if necessary.
		Recorder roller is defective.	Replace the recorder assembly.
S1.8	When the monitor is turned on, *SYSTEM FAULT:ROM* error message appears on the display.	The main board flash memory is defective.	Replace the main board.
S1.9	When the monitor is turned on, *SYSTEM FAULT:RAM* error message appears on the display.	The main board SRAM memory is defective.	Replace the main board.
S1.10	When the monitor is turned on, *SYSTEM FAULT:ALERT* error message appears on the display.	Software error	Restart the monitor and check the CPU software version of the monitor. Upgrade software if necessary (See Appendix F). If the software is up-to-date and the symptom still exists, replace the main board.
S1.11	When the monitor is turned on, *SYSTEM FAULT:UI KEYPAD* error message appears on the display.	Communication problem exists between the main board and the UI keypad board.	Make sure the inter-connect cable is securely connected.
		UI keypad board is defective.	Replaced the UI keypad board.

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General Troubleshooting Table			
ID	**Symptom Description**	**Possible Causes**	**Actions and Solutions**
S1.12	When the monitor is turned on, *SYSTEM FAULT:SOFTWARE* error message appears on the display.	SW1 switch #7 is incorrectly set.	Disable SW1 switch #7.
		Software error	Restart the monitor and check the CPU software version of the monitor. Upgrade software if necessary (See Appendix F). If the software is up-to-date and the symptom still exists, replace the main board.
S1.13	When the monitor is turned on, *SYSTEM FAULT:DEFAULTS* error message appears on the display.	Main board is defective.	Replace the main board.
S1.14	When the monitor is turned on, *SYSTEM FAULT:DSP* error message appears on the display.	DSP board is defective.	Replace the DSP board.

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5.2 Ultrasound Troubleshooting Table

Ultrasound Troubleshooting Table			
ID	**Symptom Description**	**Possible Causes**	**Actions and Solutions**
S2.1	The monitor does not show the fetal heart rate properly on the display when the ultrasound transducer is connected to the monitor.	Ultrasound transducer is not properly connected to the monitor unit.	Confirm that the transducer is securely connected to the monitor unit.
		Ultrasound transducer is not properly positioned on the patient.	Reposition the transducer and wait for a few seconds before moving the transducer.
		Too little ultrasound gel is applied to the ultrasound transducer.	Check the ultrasound gel applied to the transducer and apply more if necessary.
		The ultrasound transducer is defective.	Check the ultrasound transducer functionality as per instructions in section 3.3.3.1. Replace the transducer if necessary.
		Ultrasound signal cannot be captured due to one of the following conditions: a) Active fetus or mother b) Fetal arrhythmia or hiccups c) Extreme maternal obesity	Use an alternate technique to capture FHR.

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Ultrasound Troubleshooting Table			
ID	**Symptom Description**	**Possible Causes**	**Actions and Solutions**
S2.2	Static noise exist on the ultrasound signal	Inappropriate ultrasound transducer used.	Use GE-approved ultrasound transducers. Do not use refurbished transducers.
		Environmental noise	Keep sheets and gown off transducer. Do not hold transducer with hand.
		Active fetus	Reposition the transducer and wait for a few seconds before moving the transducer.
		The ultrasound transducer is defective.	Check ultrasound transducer functionality as per instructions in section 3.3.3.1. Replace the transducer if necessary.
		Maternal movement	Use an alternate technique to capture FHR.
S2.3	The FHR Rate shown on the display and the FHR trend on the strip chart paper do not correlate.	The paper scale is incorrectly configured to either 50-210 bpm or 30-240 bpm.	Access *Install Options Screen 1* screen and set the paper scaling to match the type of paper used.
S2.4	The volume of the ultrasound tone is low.	The tone volume is set low.	Use the Volume Buttons on the monitor to increase the volume of the ultrasound tone.
		The dual ultrasound board is out of calibration.	Contact service for calibrating the dual ultrasound board OR order a new dual ultrasound board and replace it.

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5.3 FECG Troubleshooting Table

FECG Troubleshooting Table			
ID	**Symptom Description**	**Possible Causes**	**Actions and Solutions**
S3.1	Internal FECG parameter is shown erratically or not being recorded properly.	FECG cable is not properly connected to the monitor unit.	Confirm that the cable is securely connected to the monitor unit.
		Attachment pad or leg plate is not securely attached to the patient.	Confirm the pad or the leg plate is securely attached to the patient.
		Electrode wire is not secure in the leg plate post.	Confirm the leg plate connection in the leg plate post is secure.
		Electrode is defective or not properly attached.	Check the electrode and replace it if necessary.
		Attachment pad is defective.	Check the pad and replace it if necessary.
S3.2	The FHR Rate shown on the display and the FHR trend on strip chart paper do not correlate.	Paper Scale is incorrectly configured to either 50-210 bpm or 30-240 bpm.	Access *Install Options Screen 1* screen and set the paper scaling to match the type of paper used.

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5.4 External Uterine Activity Troubleshooting Table

External Uterine Activity Troubleshooting Table			
ID	**Symptom Description**	**Possible Causes**	**Actions and Solutions**
S4.1	The TOCO transducer is not recording the contractions.	TOCO transducer is not properly connected to the monitor unit.	Confirm that the transducer is securely connected to the monitor unit.
		TOCO transducer is not properly positioned on the patient.	Reposition the transducer and confirm it is securely applied to the patient.
		UA reference range exceeded.	Loosen belts or remove transducer from patient. Press UA Reference button while no pressure is applied to transducer button. Re-apply transducer. Do not over-tighten the belt. Press UA Reference button again between contractions.
		No maternal contractions exist.	Securely apply the TOCO transducer to the patient and wait for maternal contractions.
		The TOCO transducer is defective.	Check the TOCO transducer functionality as per instructions in section 3.3.3.2. Replace the transducer if necessary.
S4.2	Flashing "+" sign appears in the UA field on the screen.	Relative pressure is more than 100.	Press the UA Reference button between the contractions.
		The UA board is defective.	Replace the UA board.

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External Uterine Activity Troubleshooting Table			
ID	**Symptom Description**	**Possible Causes**	**Actions and Solutions**
S4.3	*CHECK TOCO* message is shown in UA area of the display when the UA Reference button is pressed.	UA Reference button is pressed before the UA circuitry is stabilized.	Make sure to wait ten seconds following powering on the monitor and/or connecting the transducer to the UA connector.
		UA reference range exceeded because the belt is over-tightened.	Loosen the belt or remove the transducer from patient. Press UA Reference button while no pressure is applied to the transducer button. Re-apply transducer. Do not over-tighten belt. Press UA Reference button again between the contractions.
		The TOCO transducer is defective.	Check the TOCO transducer functionality as per instructions in section 3.3.3.2 Replace the transducer if necessary.
		UA board is defective.	Replace the UA board.

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5.5 Internal Uterine Activity Troubleshooting Table

Internal Uterine Activity Troubleshooting Table			
ID	**Symptom Description**	**Possible Causes**	**Actions and Solutions**
S5.1	Internal pressure parameter is not being measured correctly.	The transducer is not properly connected to the monitor unit.	Confirm that the transducer is securely connected to the monitor unit.
		Air bubble exists in the dome or the catheter is blocked.	Flush the dome and the catheter.
		Dome is cracked.	Inspect the dome for damages and replace it if necessary.
		Catheter has fallen out of place.	Inspect the catheter and replace it if necessary.
		Catheter or strain gauge is not zeroed.	Calibrate catheter or strain gauge.
		UA board is defective.	Replace the UA board.
S5.2	*CHECK IUP* message is shown in UA area of the display.	Blockage exists in fluid-filled catheter.	Flush the catheter and Re-zero. Replace the catheter if necessary.
		Fetus is pressing directly on the catheter.	Reposition by twisting the catheter.
		The catheter is defective.	Check the catheter functionality. Replace the transducer if necessary.

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5.6 MECG Troubleshooting Table

MECG Troubleshooting Table			
ID	**Symptom Description**	**Possible Causes**	**Actions and Solutions**
S6.1	MECG parameter is shown erratically or not being properly recorded.	The cable is not properly connected to the monitor unit.	Confirm that the cable is securely connected to the monitor unit.
		Electrode gel is dried.	Check electrodes and re-apply gel if necessary.
		Electrodes are not properly placed.	Re-apply electrodes.
		Clips are not attached to electrodes properly.	Check clip attachments.
		Selected lead is providing inadequate signal.	Change lead selection on MHR/P Setup screen.
		The MECG cable is defective.	Inspect the cable and replace it if necessary.
		MECG board is defective.	Replace the MECG board.
S6.2	Dashes (– – –) are shown in MHR/P area of the display.	Monitor is unable to make a determine MECG due to insufficient signal.	Confirm that the patient is not asystolic and the electrodes are firmly secured to the patient.
		MECG board is defective.	Replace the MECG board.

5.7 Blood Pressure Troubleshooting Table

Blood Pressure Troubleshooting Table			
ID	**Symptom Description**	**Possible Causes**	**Actions and Solutions**
S7.1	High reading	Measurement is taken during uterine contraction.	Annotate chart, then take a manual reading in-between contractions. If possible, cancel reading during contraction. Enable the monitor's Smart BP feature.

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Blood Pressure Troubleshooting Table			
ID	**Symptom Description**	**Possible Causes**	**Actions and Solutions**
S7.2	*CHECK CUFF* message is shown in NIBP area of the display.	Improper cuff position or loose cuff.	Reposition the cuff and confirm that the cuff is properly tightened.
		Maternal movement	Restrict patient limb movement. Restrain limb if necessary.
		Hose is not properly connected to monitor (air pressure error).	Make sure that hose is firmly attached to the monitor.
		Neonatal cuff is used for the measurement.	Confirm that an adult cuff is used for the measurement.
		NIBP board is defective.	Replace the NIBP board.
S7.3	*OVERPRESSURE* message is shown in NIBP area of the display.	Cuff pressure has exceeded the over-pressure limit of 315 mmHg ± 15 mmHg.	Restrict patient limb movement. If the symptom still exists, the NIBP hose or the NIBP board is defective. Contact service.
		The hose is kinked.	Check the external cuff for kinks.
		The hose is blocked.	Perform pneumatic test.
S7.4	COMM message is shown in NIBP area of the display.	Communication error exists between the built-in NIBP module and the monitor circuitry.	The NIBP board or the main board is defective. Contact service.
S7.5	*MOTION* message is shown in NIBP area of the display.	Excessive maternal movement.	Restrict patient limb movement. Restrain limb if necessary.
S7.6	Dashes (– – –) are shown in NIBP area of the display.	Monitor is unable to determine the blood pressure.	Reposition cuff. Ensure the patient is not arrhythmia and move cuff to another limb. If the symptom still exists, contact service.
S7.7	*REPAIR* message is shown in NIBP area of the display.	NIBP Pump is defective.	Replace the NIBP pneumatic board.
		System error or self-test failure.	The NIBP board or the main board is defective. Contact service.

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Blood Pressure Troubleshooting Table			
ID	**Symptom Description**	**Possible Causes**	**Actions and Solutions**
S7.8	*WEAK SIGNAL* message is shown on the display.	Monitor is unable to determine the blood pressure due to insufficient signal.	Assess patient situation.

5.8 Maternal Pulse Oximetry Troubleshooting Table

Maternal Pulse Oximetry Troubleshooting Table			
ID	**Symptom Description**	**Possible Causes**	**Actions and Solutions**
S8.1	*COMM* message is shown in $MSpO_2$ area of the display.	Communication error exists between the built-in $MSpO_2$ module and the monitor circuitry.	The SpO_2 module + carrier board or the main board is defective. Contact service.
S8.2	Dashes (---) are shown in $MSpO_2$ area of the display.	The sensor is improperly applied on the patient's finger.	Ensure the sensor is not too tight. Move the sensor to another location.
		Maternal movement.	Restrict patient limb movement. Restrain limb if necessary.
		Excessive ambient light exists.	Cover the sensor with opaque material.
		Monitor is unable to determine the pulse oximetry due to insufficient signal.	Confirm that the intermediate cable is firmly attached to the monitor and to the sensor assembly.
		The wrong SpO_2 sensor is connected to the monitor.	Use the same SpO_2 sensor type (Nellcor, Masimo) that the monitor supports.
		The sensor is defective.	Inspect the sensor and replace it if necessary.
		The SpO_2 module + carrier board is defective.	Replace the SpO_2 module + carrier board.
S8.3	MHR/P Pulse source is blank when $MSpO_2$ is selected	Normal mode is selected.	Select Fast mode on *$MSpO_2$ Setup* screen.

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Maternal Pulse Oximetry Troubleshooting Table			
ID	**Symptom Description**	**Possible Causes**	**Actions and Solutions**
S8.4	REPAIR message is shown in $MSpO_2$ area of the display. (Nellcor only)	System error or self-test failure.	Verify the settings of SW1 switch on the main board are correct. If the symptom still exists, the SpO_2 module + carrier board or the main board is defective. Contact service.
S8.5	The monitor does not show any $MSpO_2$ value and *SENSOR* message appears below the $MSpO_2$ area of the display.	The wrong SpO_2 sensor is connected to the monitor.	Use the same SpO_2 sensor type (Nellcor, Masimo) that the monitor supports

5.9 Main Board Troubleshooting – Voltage Checks

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

1. Make sure the monitor is turned off.
2. Remove the top cover as instructed in section 6.1
3. Turn the monitor on.
4. Use a multimeter to measure and verify the below power supply voltages on J14 connector pins of the main board. Use pin 8 of J14 as the ground (GND) for the voltage measurements.

J14 Pin Number	Signal Name	Acceptable Voltage Range
1	+12EL	+12 VDC ±0.5 VDC
2	+20I	+20 VDC ± 0.5 VDC
3	+15BP	+15 VDC ± 0.5 VDC
4	-15V	-15 VDC ± 0.5 VDC
5	+15V	+15 VDC ± 0.5 VDC
6	+12A	+12 VDC ± 0.5 VDC
7	+5V	+5 VDC ± 0.5 VDC
8	GND	--
9	No Connection	--
10	Keying	--

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5.10 FECG/UA Board Troubleshooting – Voltage Adjustments

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

1. Make sure the monitor is turned off.
2. Remove the top cover as instructed in section 6.1.
3. Remove the cage cover.
4. Turn the monitor on.
5. Set a multimeter to measure DC voltage. Connect the positive lead of the multimeter to TP1 and the negative lead to TP2 or TP3 (isolated ground) on the FECG/UA board.
6. Confirm that the multimeter reads a DC voltage of +4.0V ± 0.01V. Adjust R28 if necessary.

5.11 Recorder Troubleshooting

5.11.1 Vertical Offset Adjustment

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

Follow below instructions to perform vertical offset adjustment if the recorder prints the horizontal traces with offset, i.e. upon running the self-test routine or recorder calibration test, the first horizontal trace is outside the acceptable range. The acceptable range is 0.49” ± 0.002” from the right hand edge of the paper.

1. Remove the top cover as instructed in section 6.1.
2. Turn on the unit and use the Trim Knob Control to go to *Install Options Screen 1* and access D*iagnostic Control* screen.
3. Use a small hex key to loosen the two set screws on both sides of the recorder assembly (See Figure 5-1).

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4. Use a hex key to adjust the one hex-head screw (See Figure 5-2) on the right side of the recorder assembly (the one lower hex-head screw on the side where stepper motor is attached)

5. Set the Recorder Calibration in the *Diagnostic Control* screen to *On* and press the Trim Knob Control to select it. Run the test for at least 10 seconds and check if the first horizontal trace falls within the specified acceptable range.

6. Set the Recorder Calibration to *Off* and press the Trim Knob Control to select it. Go back to step 4 to do further adjustment if the first horizontal trace falls outside the specified acceptable range.

7. Turn off the monitor.

8. Tighten the two set screws on both sides of the recorder assembly (See Figure 5-1).

9. Re-install the top cover.

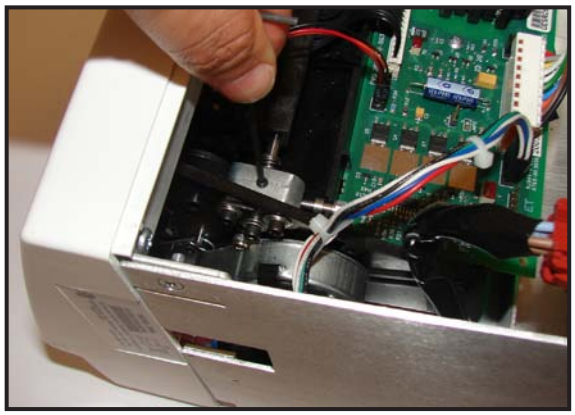

Figure 5-1

Figure 5-2

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5.11.2 Horizontal Offset Adjustment

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

Use the Trim Knob Control to go to Install Options Screen 1 and access Diagnostic Control screen to run the recorder calibration test. Follow below instructions to perform the horizontal offset adjustment if any of the following symptoms are detected:

- The recorder paper consistently curls to one side.
- Printing of unequal weight occurs along the vertical trace line, from one end to the other.
- Dots are missing along the vertical trace.
- Printing is too light following the recorder thermal print head replacement.

NOTE: If skewing occurs, check for other malfunctions. Noticeable skewing of a vertical line printed on the strip chart paper is usually accompanied by one of the above-mentioned symptoms.

1. Remove the top cover as instructed in section 6.1.

2. Use a hex key to loosen the four hex-head lock screws, two on each side of the recorder assembly (See Figure 5-3).

3. To move the recorder thermal print head forward on one side for horizontal adjustment, use long nose pliers to back-off the corresponding captive screw (turn counterclockwise) from its alignment block (See Figure 5-4). To move the recorder thermal print head backward on one side for horizontal adjustment, use long nose pliers to tighten the corresponding captive screw (turn clockwise).

4. After making the necessary adjustments, use a hex key to tighten the four hex-head lock screws (See Figure 5-3).

5. Re-install the top cover.

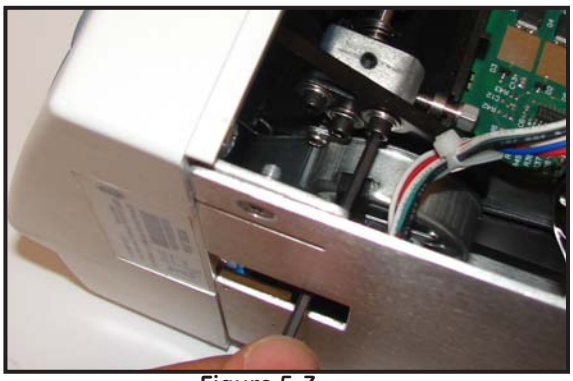

Figure 5-3

Figure 5-4

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5.11.3 Light Printing

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

If the monitor recorder (intermittently) prints too lightly such that the prints on fetal chart paper are barely legible, follow the troubleshooting flowchart (Figure 5-5) and the table to fix the issue. Load the monitor recorder with the GE-approved chart paper. Close the recorder door and allow 1-2 pages to roll out by pressing the Paper Advance button. Set the display to service mode and then press test button to get a test print.

NOTE: Don't touch the thermal print head heating element with bare hand.

NOTE: Paper should be installed in the monitor's strip chart recorder at all times. This reduces particle build-up on TPH and facilitates opening the recorder door.

NOTE: Do not rotate the recorder roller without having chart paper.

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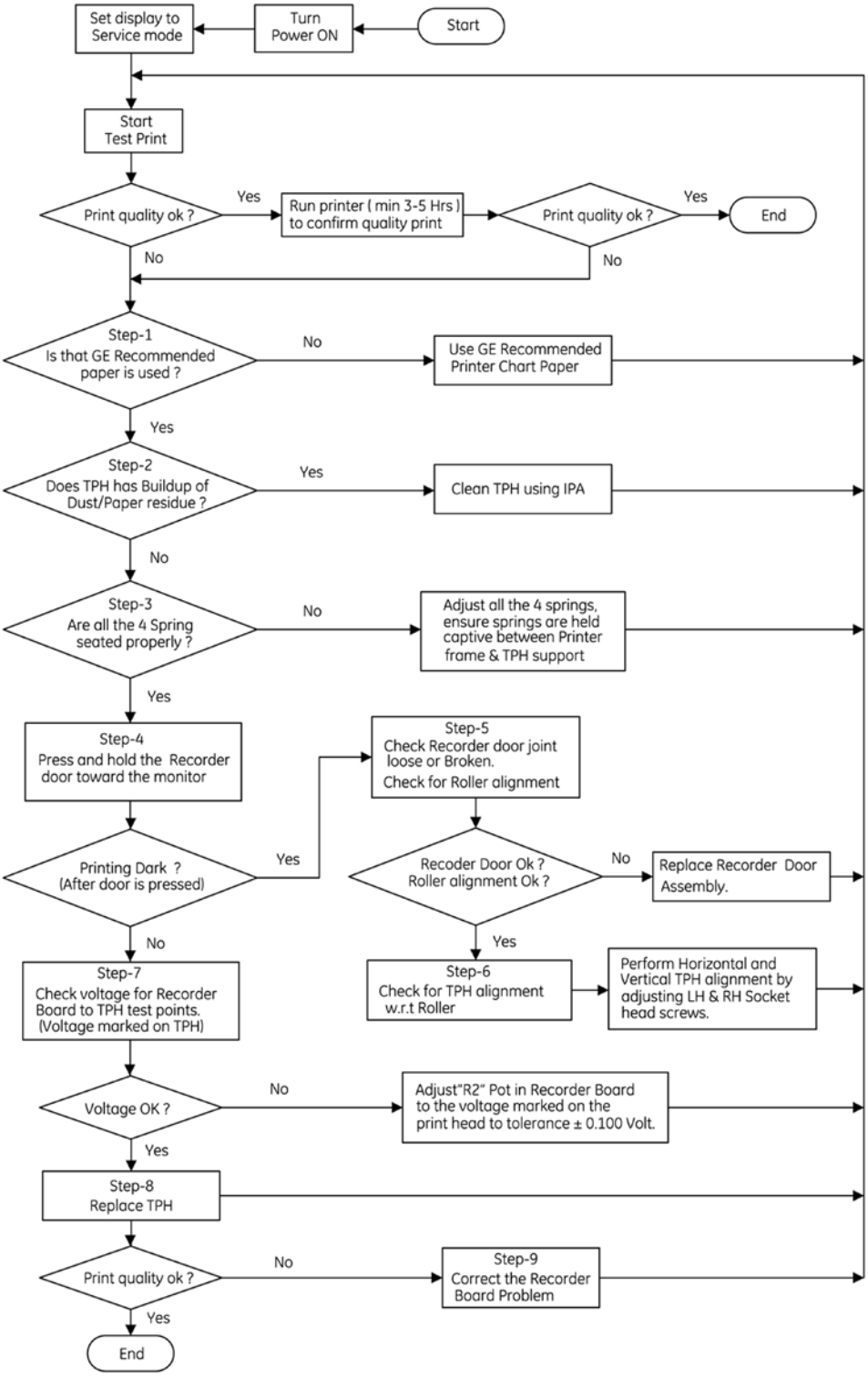

Figure 5-5 Recorder Light Printing Symptom - Troubleshooting Flowchart

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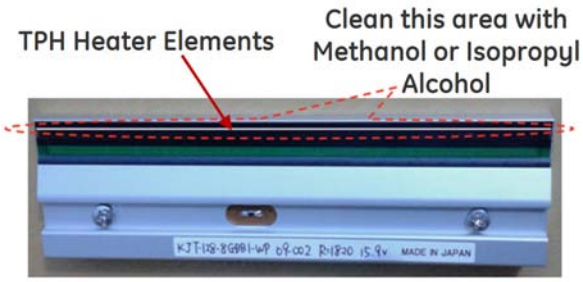
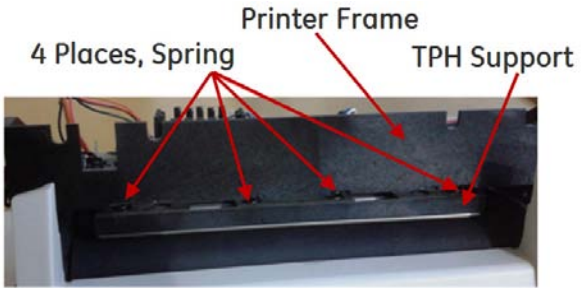
<table>
<tr><th colspan="4">Recorder Light Printing Troubleshooting Table</th></tr>
<tr><th>ID</th><th>Symptom Description</th><th>Possible Causes</th><th>Actions and Solutions</th></tr>
<tr><td rowspan="3">S11.1</td><td rowspan="3">The monitor recorder (intermittently) prints too lightly such that the prints on fetal chart paper are barely readable.</td><td>Inappropriate fetal chart paper is used.</td><td>Use GE-Recommended fetal chart paper only (Part numbers: 2009828-CAO, 2009828-DAO, 2009828-FAO).</td></tr>
<tr><td>Paper residue, dust or other material is built up on thermal print head (TPH).</td><td>Use cotton swabs and methanol or isopropyl alcohol to clean the thermal print head (See section 3.3.2). Care must be taken not to touch the heater elements while cleaning. Check for missing segments on chart paper after cleaning.
 
</td></tr>
<tr><td>Thermal print head pressure is uneven because the springs are not seated properly.</td><td>Ensure all four springs are held captive between TPH support and the recorder frame.
 
</td></tr>
<tr><td></td><td>Recorder door assembly is broken or loose. Press and hold the recorder door toward the monitor. If printing darkens on either side, check if recorder door assembly is broken or loose causing the roller alignment to be out of adjustment (recorder door heat staking joint loose or broken).</td><td>Replace the recorder assembly.
</td></tr>
</table>

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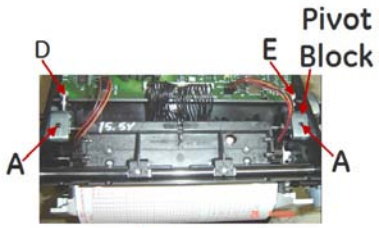
Recorder Light Printing Troubleshooting Table			
ID	**Symptom Description**	**Possible Causes**	**Actions and Solutions**
		Thermal print head (TPH) is not aligned properly with respect to the roller. Press and hold the recorder door toward the monitor. If printing darkens on either side with no recorder door assembly broken or loose, then TPH alignment needs adjustment.	 Recorder Top View Recorder Left View Recorder Right View **Note**: Don't touch the TPH heating element with bare hand. Perform Horizontal Offset Adjustment: 1) Loosen four Socket Head Lock screws (label B), 2 No's on either side L.H. and R.H 2) With the help of Pivot blocks alignment screws (label-D and E) fine adjust the movement of recorder head forward and backward to attain a dark print. Ensure it prints black lines parallel to chart paper horizontal grid lines. 3) Check for printing uniform line darkness and there are no missing dots or light print. 4) 4) Tighten the corresponding Socket Head Lock screws (label –B) to a torque of 9kgf cm L.H. and R.H (4 Places). Perform Vertical Offset Adjustment: 1) Loosen the vertical adjustment Set screws (label- A). 2) Fine adjust movement of TPH using Socket Head Lock screw (Label- C). Move print head right or left, until the first dot of the

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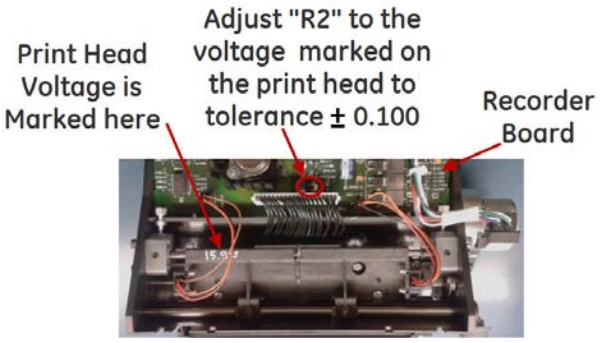
Recorder Light Printing Troubleshooting Table			
ID	**Symptom Description**	**Possible Causes**	**Actions and Solutions**
			horizontal lines is 0.490 ±0. 010 from the inside edge of the right hand edge of the paper. Use film scale or vernier calipers for measurement. 3) Check the print line alignment is within spec. 4) Check for chart paper printing black. 5) Manually tighten the Set screws (label- A).
		Print Head voltage is incorrect.	Set a multimeter to measure DC voltage. Connect the positive lead of the multimeter to pin 4 of J6 on the recorder board and connect the negative lead to pin 4 of J5 connector on the recorder board. Set the voltage by adjusting R2 on the recorder board to the VHEAD ± 0.1 Volt. VHEAD is the voltage value marked on the print head support (each print head is unique). 
		Thermal print head is defective.	Replace the thermal print head (See section 6.22). **Note**: Don't touch the thermal printer head (TPH) heating element with bare hand.
		Recorder board is defective.	Replace the recorder board (See section 6.18).

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Chapter 6: Repair and Replacement Procedures

This chapter describes the procedures used for replacement of the Corometrics™ 250cx Series monitor parts. After any replacement procedure, perform the checkout procedures as described in Chapter 3.

Always read all the warnings, cautions, notes, and other information provided in "Important Service Safety Information" before starting any replacement or repair. All replacement and repair procedures shall be performed by authorized service personnel only.

CAUTION:
Genuine spare parts manufactured or sold by GE Healthcare must only be used for all repair and replacement procedures.

NOTE: Standard service tools (such as nut driver, long nose pliers, hex keys, and Phillips screw driver) are required to perform the repair and replacement procedures.

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6.1 Top Cover, Top Cover Gasket, and Timekeeping RAM Chip Replacement

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

1. Confirm the monitor is turned off and the power cord is unplugged from the power outlet.

2. Use a Phillips screw driver to remove the screws (on the rear and bottom sides of the monitor) that attach the top cover gasket to the unit chassis.

3. Place the monitor on a flat surface and gently slide the top cover out by pushing it towards the rear side of the unit.

4. To remove the top cover gasket, hold the gasket on the inside front edge of the top cover and pull it free of the cover. Clean the stamping area where the gasket was adhered to the cover by wiping the surface with isopropyl alcohol.

5. To replace the timekeeping RAM chip (U30) on the main board, use a small screw driver or pliers to remove the chip from its socket on the main board and then install the new chip into the socket.

6. Reverse steps to re-install. To re-install a new gasket, align the front edge of the gasket along the stamping line on the inside of the top cover and apply pressure to secure it. Ensure the adhesive of the gasket is completely sealed all along the stamping line.

CAUTION:
The top cover gasket protects the inside of the unit against fluid spills. Always make sure the gasket is securely attached across the whole front of the top cover along the stamping line before re-installing the top cover. Order a new gasket and replace it if the adhesive of the existing gasket is no longer effective.

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6.2 Speaker Replacement

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

1. Remove the top cover as instructed in section 6.1.
2. Disconnect external display ribbon cable from J9 on DSP/Display board (See Figure 6-1).
3. Disconnect the speaker cable from the J10 connector on the main board.
4. Use a nut driver to remove the nuts and flat washers that attach the speaker to the mounting posts (See Figure 6-2) and remove the speaker.
5. Reverse steps to re-install.

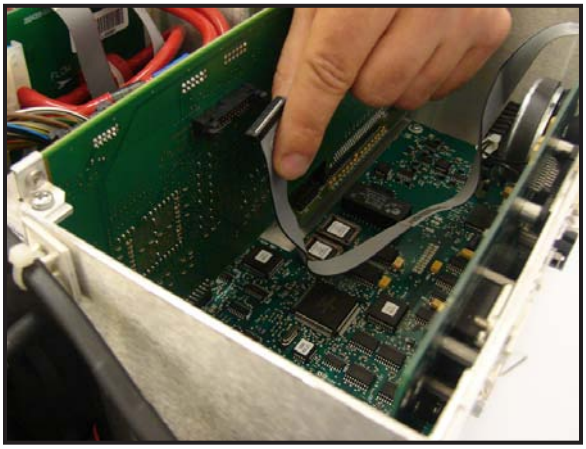

Figure 6-1

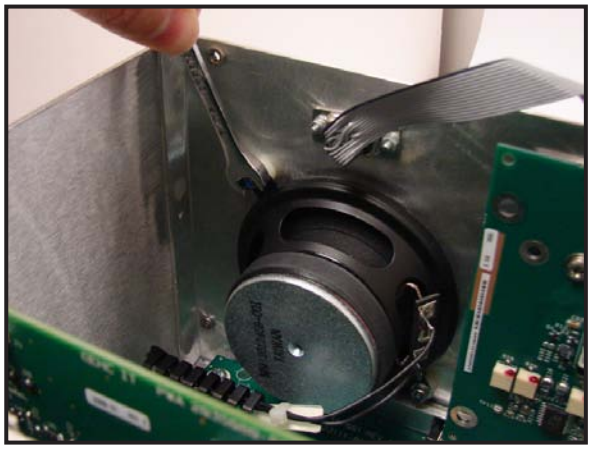

Figure 6-2

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6.3 DSP/Display Board Replacement

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

1. Remove the top cover as instructed in section 6.1.
2. Disconnect the inverter cable from the J1 connector on the DSP/Display board (See Figure 6-3).
3. Disconnect the DSP-to-LCD Decoder ribbon cable from the J2 connector on the DSP/Display board (See Figure 6-4).

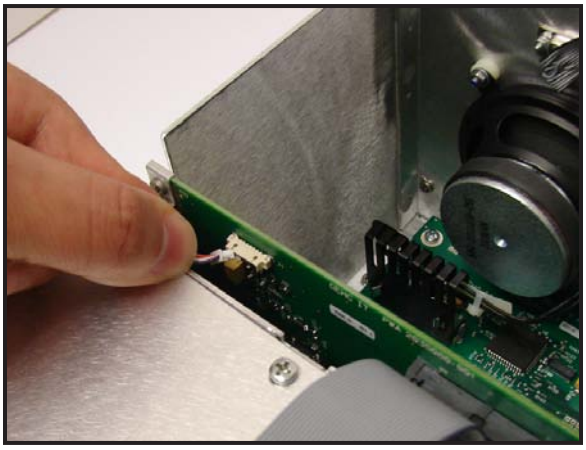

Figure 6-3

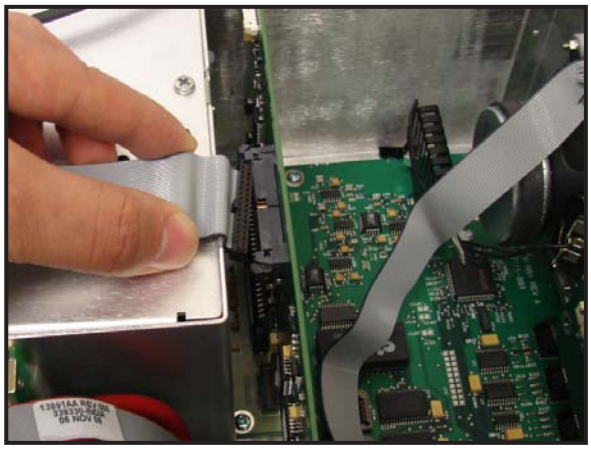

Figure 6-4

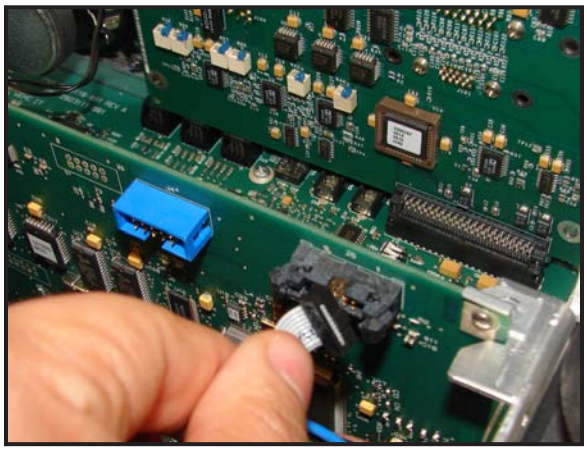

Figure 6-5

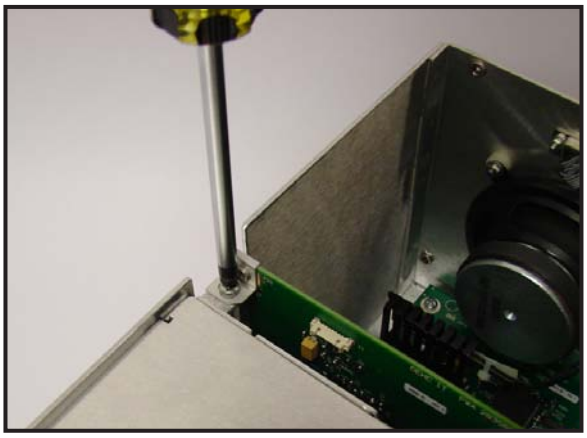

Figure 6-6

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4. Disconnect the DSP-to-Keypad ribbon cable from the J5 connector on the DSP/Display board (See Figure 6-5).

5. Disconnect the external display cable from J9 connector on the DSP/Display board (See Figure 6-1).

6. Use a Phillips screw driver to remove the two screws that attach the DSP/Display board to the chassis (See Figure 6-6).

7. Pull the DSP/Display board up gently to disconnect it from the main board and slide it out.

8. Reverse steps to re-install.

6.4 Communication Board Replacement

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

1. Remove the top cover as instructed in section 6.1.

2. Use a Phillips screwdriver to remove the four screws on the rear side of monitor unit that attach the communication board and its plate (the metal plate that the communication board is fixed to) to the chassis (See Figure 6-7).

3. Pull up the communication board and plate gently to disconnect the communication board from the main board.

4. Reverse steps to re-install.

Figure 6-7

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6.5 Pneumatics Assembly Replacement

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

1. Remove the top cover and the DSP/Display board as instructed in sections 6.1 and 6.3.

2. Use a Phillips screw driver to remove the two screws (on both sides of the monitor) that attach the front bezel to the chassis (See Figure 6-8).

3. Open the recorder door (When closed, the door will interfere with the bezel movement).

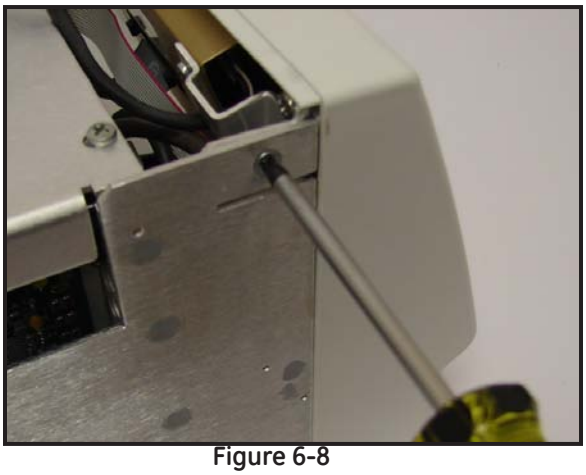

Figure 6-8

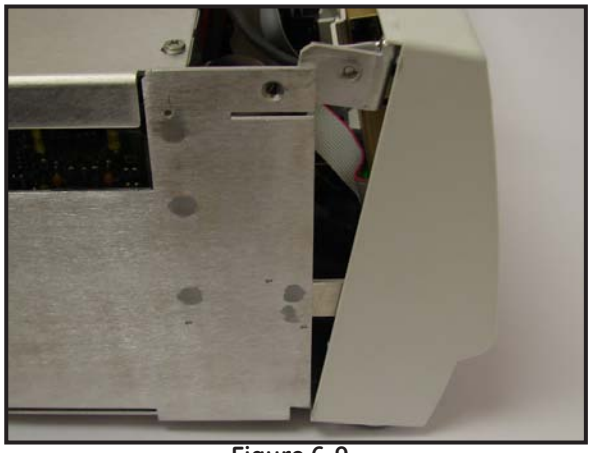

Figure 6-9

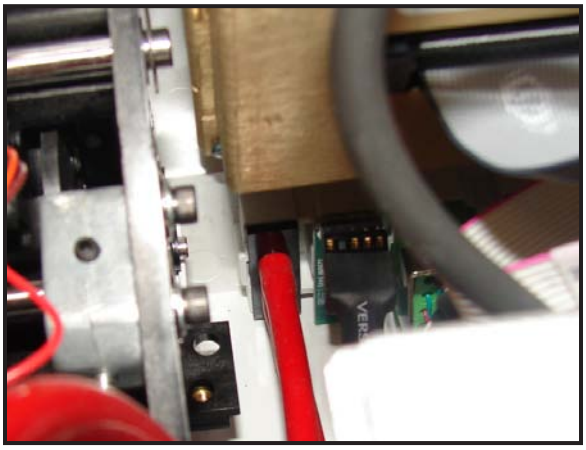

Figure 6-10

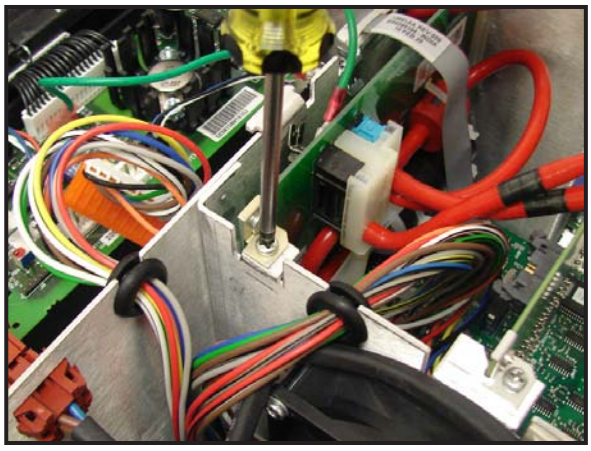

Figure 6-11

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4. Tilt the front bezel forward and away from the chassis to make the rear side of the NIBP connector on the bezel accessible (See Figure 6-9).

5. Pull and disconnect the two red pneumatics tubes from the NIBP connector on the back of the bezel (See Figure 6-10).

6. Pull the red tubes out of the chassis grommet.

7. Use a Phillips screw driver to remove the two screws that attach the pneumatics board to the chassis (See Figure 6-11).

8. Disconnect the “clear” tubes from both PT1 and PT2 transducers on the main board (See Figure 6-12).

NOTE: Make a note of the “clear” tubes connection order before disconnecting them to re-install properly.

9. Disconnect the recorder cable from the J9 connector on the main board (See Figure 6-13).

10. Pull up the pneumatics board gently to disconnect it from the main board and remove it.

11. Reverse steps to re-install.

NOTE: To re-install “clear” tubes properly, make sure that the tube from E1 on pneumatic board is connected to PT1 on the main board and the tube from E2 is connected to PT2.

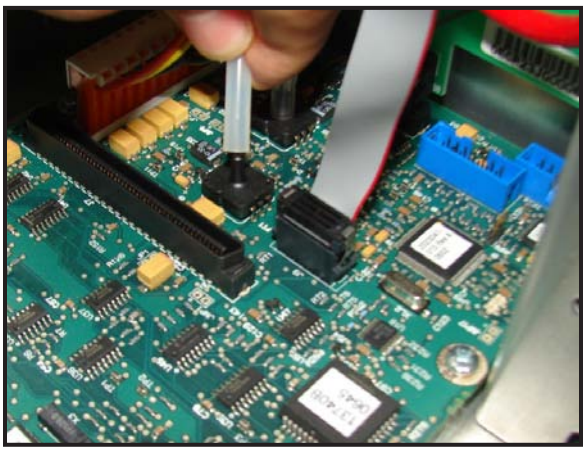

Figure 6-12

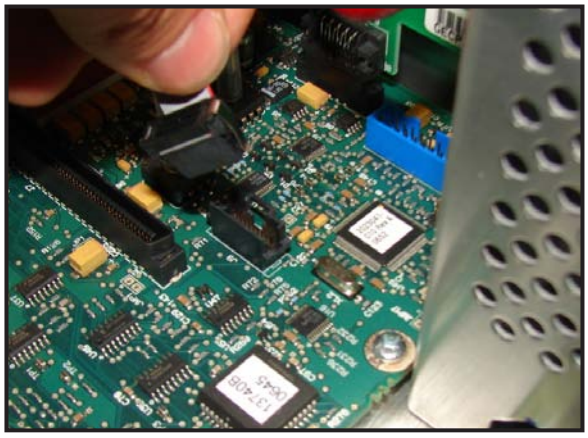

Figure 6-13

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6.6 Main Board Replacement

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

1. Remove the top cover, DSP/Display board, and communication board as instructed in sections 6.1, 6.3, and 6.4.

2. Disconnect the recorder cable from the J9 connector on the main board (See Figure 6-13).

3. Use a Phillips screw driver to remove the two screws that attach the pneumatics board to the chassis (See Figure 6-11).

4. Disconnect the “clear” tubes from both PT1 and PT2 transducers on the main board (See Figure 6-12). Do not disconnect the red pneumatic tubes from the NIBP connector on the bezel.

NOTE: Make a note of the “clear” tubes connection order before disconnecting them to re-install properly.

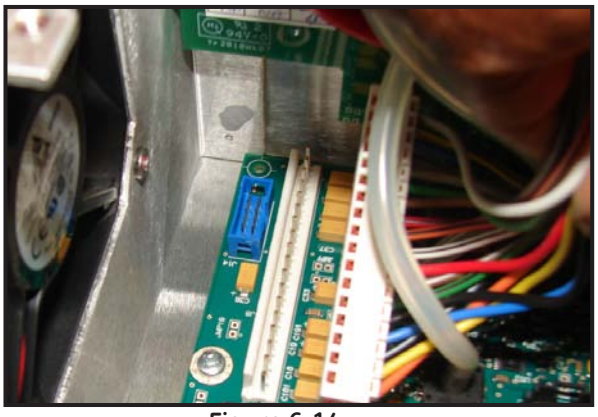

Figure 6-14

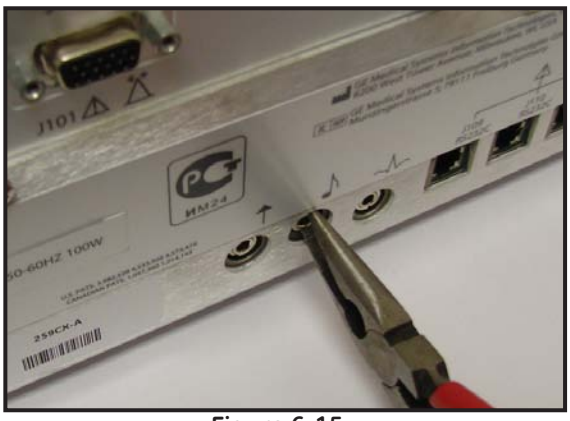

Figure 6-15

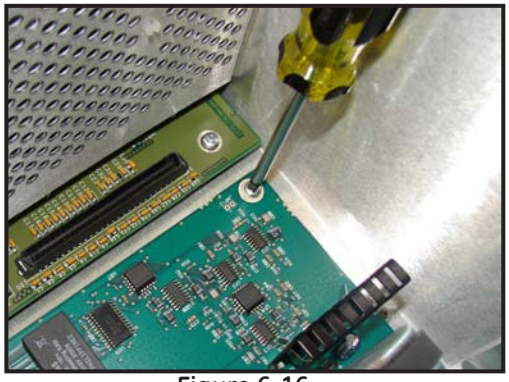

Figure 6-16

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5. Pull up the pneumatics board gently to disconnect it from the main board and remove it.

6. Disconnect the power supply cable from the J8 connector on the main board (See Figure 6-14).

7. Disconnect the speaker cable from the J10 connector on the main board.

8. Use long nose pliers to remove nuts from PH1, PH2, and PH3 connectors that attach EMI plate to the main board (See Figure 6-15).

9. Use a Phillips screw driver to remove the six screws that attach the main board to the chassis and then remove the main board (See Figure 6-16).

10. Reverse steps to re-install.

NOTE: To re-install "clear" tubes properly, make sure that the tube from E1 on pneumatic board is connected to PT1 on the main board and the tube from E2 is connected to PT2.

6.7 Display Assembly Replacement

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

1. Remove the top cover as instructed in section 6.1.

2. Disconnect the inverter cable from the J1 connector on the DSP/Display board (See Figure 6-3).

3. Disconnect the DSP-to-LCD Decoder ribbon cable from the J2 connector on the DSP/Display board (See Figure 6-4).

4. Disconnect the DSP-to-Keypad ribbon cable from the J5 connector on the DSP/Display board (See Figure 6-5).

5. Disconnect the recorder cable from the J9 connector on the main board (See Figure 6-13).

6. Use a Phillips screw driver to remove the two screws (on both sides of the monitor) that attach the front bezel to the chassis (See Figure 6-8).

7. Open the recorder door (When closed, the door will interfere with the bezel movement).

8. Tilt the front bezel forward and away from the chassis (See Figure 6-9).

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9. Disconnect the Keypad-to-Volume ribbon cable from its connector on volume keypad board (See Figure 6-17).

10. Use a Phillips screw driver to remove the screw that attach display mounting bracket to the front bezel (See Figure 6-18) and then remove the screw that attach the bracket to the display assembly (See Figure 6-19) to remove the bracket.

11. Use a Phillips screw driver to remove the four screws that attach the display assembly to the front bezel to release the display assembly (See Figure 6-20).

12. Remove the display lens.

13. Reverse steps to re-install.

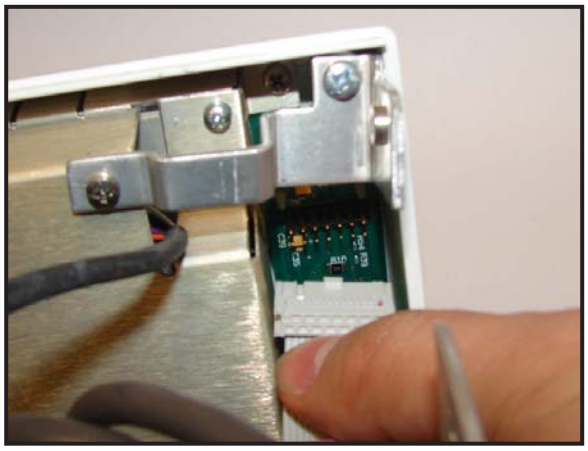

Figure 6-17

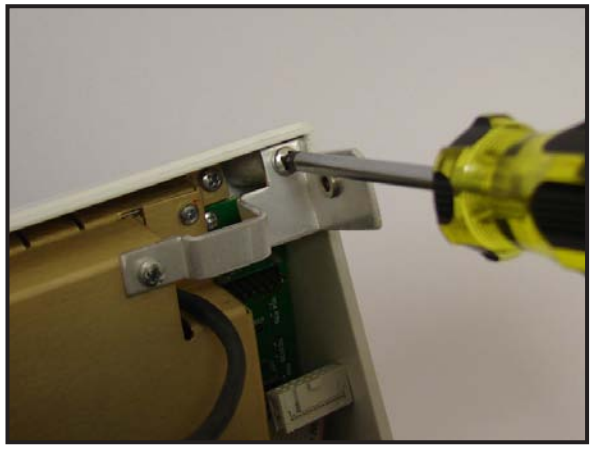

Figure 6-18

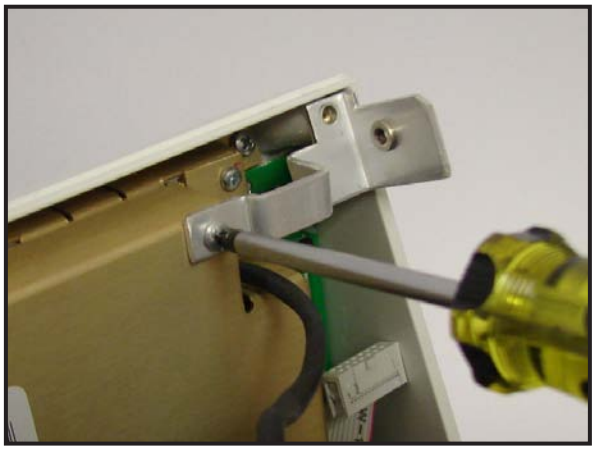

Figure 6-19

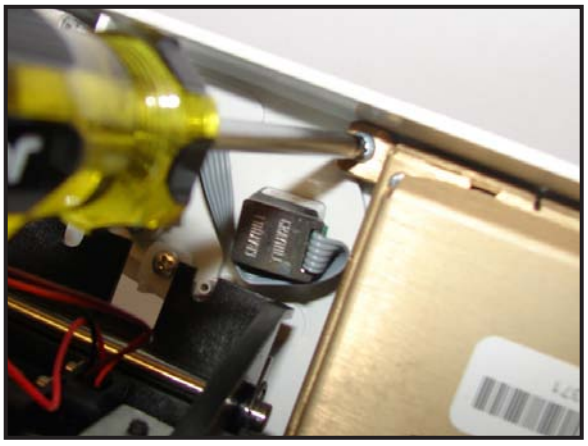

Figure 6-20

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6.8 Power Switch Assembly Replacement

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

1. Remove the top cover as instructed in section 6.1.
2. Disconnect the inverter cable from the J1 connector on the DSP/Display board (See Figure 6-3).
3. Disconnect the DSP-to-LCD Decoder ribbon cable from the J2 connector on the DSP/Display board (See Figure 6-4).
4. Disconnect the DSP-to-Keypad ribbon cable from the J5 connector on the DSP/Display board (See Figure 6-5).
5. Use a Phillips screw driver to remove the two screws (on both sides of the monitor) that attach the front bezel to the chassis (See Figure 6-8).
6. Open the recorder door (When closed, the door will interfere with the bezel movement).
7. Tilt the front bezel forward and away from the chassis (See Figure 6-9).
8. Disconnect the power switch cable from the power supply bulkhead-mounted connector (See Figure 6-21).
9. Use long nose pliers to disconnect the four Fast-on tab connectors from the power switch.
10. Remove the metal retaining clip from the power switch.
11. Push power switch out through front bezel.
12. Reverse steps to re-install.

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6.9 Trim Knob Control Assembly Replacement

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

1. Remove the top cover as instructed in section 6.1.
2. Disconnect the inverter cable from the J1 connector on the DSP/Display board (See Figure 6-3).
3. Disconnect the DSP-to-LCD Decoder ribbon cable from the J2 connector on the DSP/Display board (See Figure 6-4).
4. Disconnect the DSP-to-Keypad ribbon cable from the J5 connector on the DSP/Display board (See Figure 6-5).
5. Use a Phillips screw driver to remove the two screws (on both sides of the monitor) that attach the front bezel to the chassis (See Figure 6-8).
6. Open the recorder door (When closed, the door will interfere with the bezel movement).
7. Tilt the front bezel forward and away from the chassis (See Figure 6-9).
8. Disconnect the Keypad-to-Volume ribbon cable from the connector on the keypad board (See Figure 6-22).
9. Disconnect the encoder cable from the keypad board (See Figure 6-23).

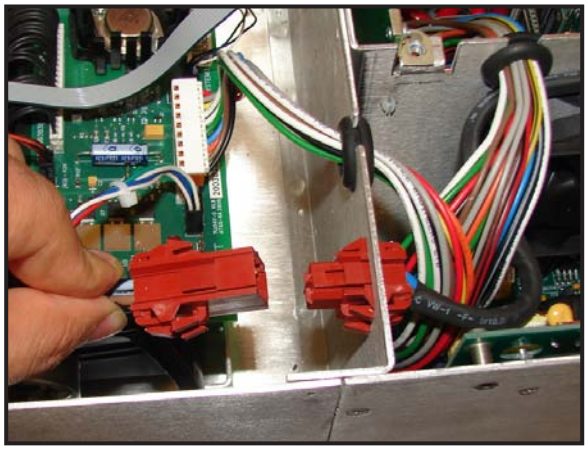

Figure 6-21

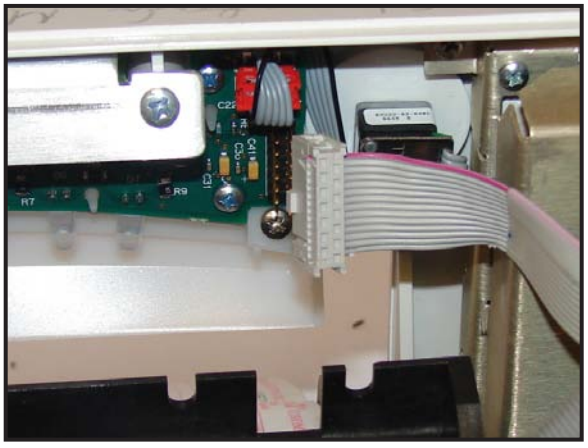

Figure 6-22

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10. Pull out the trim knob and use long nose pliers to remove the encoder washer and the encoder.

11. Reverse steps to re-install.

6.10 Keypads Replacement

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

1. Remove the top cover as instructed in section 6.1.

2. Disconnect the inverter cable from the J1 connector on the DSP/Display board (See Figure 6-3).

3. Disconnect the DSP-to-LCD Decoder ribbon cable from the J2 connector on the DSP/Display board (See Figure 6-4).

4. Disconnect the DSP-to-Keypad ribbon cable from the J5 connector on the DSP/Display board (See Figure 6-5).

5. Use a Phillips screw driver to remove the two screws (on both sides of the monitor) that attach the front bezel to the chassis (See Figure 6-8).

6. Open the recorder door (When closed, the door will interfere with the bezel movement).

7. Tilt the front bezel forward and away from the chassis (See Figure 6-9).

8. To remove the volume keypad board:

    a. Disconnect the Keypad-to-Volume ribbon cable from the connector on the volume keypad board.

    b. Use a Phillips screw driver to remove the screw that attach display mounting bracket to the front bezel (See Figure 6-18) and then remove the screw that attach the bracket to the display assembly (See Figure 6-19) to remove the bracket.

    c. Use a Phillips screw driver to remove the four screws that attach the volume keypad board to the front bezel and remove the volume keypad board and the pad.

9. To remove the keypad board:

    a. Disconnect the Keypad-to-Volume ribbon cable from the connector on the keypad board (See Figure 6-22).

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b. Disconnect the encoder cable from the keypad board (See Figure 6-23).

c. Use a Phillips screw driver to remove the two screws that attach the keypad bracket to the front bezel (See Figure 6-24) and remove the keypad bracket.

d. Use a Phillips screw driver to remove the four screws that attach the keypad to the front bezel and remove the keypad board and the pad.

10. Reverse steps to re-install.

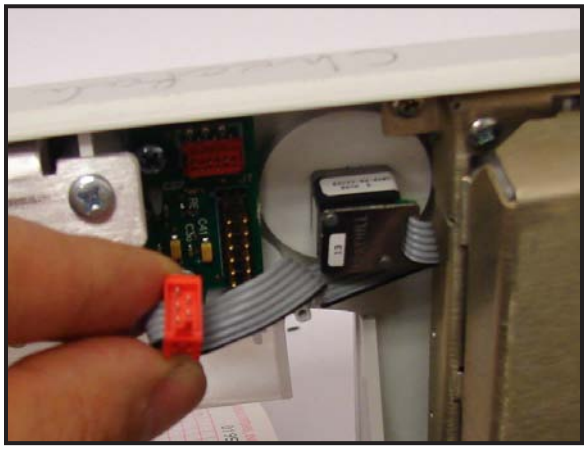

Figure 6-23

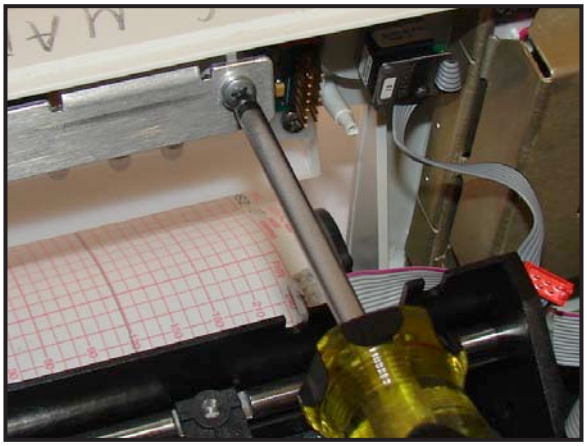

Figure 6-24

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6.11 Main Power Supply / Fan Replacement

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

1. Remove the top cover and the DSP/Display board as instructed in sections 6.1 and 6.3.
2. Cut tie-wrap holding power-switch cable to cable-tie mount on chassis.
3. Disconnect the power switch cable from the power supply bulkhead-mounted connector (See Figure 6-21).
4. Use long nose pliers to release the power supply bulkhead-mounted connector from the chassis.
5. Disconnect the power supply cable from J1 connector on the recorder board (See Figure 6-25). Slide grommet out of bulkhead.
6. Disconnect the power supply cable from J8 connector on the main board (See Figure 6-14). Slide grommet out of bulkhead.
7. Use a Phillips screw driver to remove the three screws from the side of the power supply (See Figure 6-26).
8. Use a Phillips screw driver to remove the four pan-head screws from the back of the power supply (See Figure 6-27).
9. Use a Phillips screw driver to remove the one pan-head screw from the inside bottom of the power supply (See Figure 6-28).
10. Unplug the fan from the power supply.
11. Remove the power supply from the chassis.
12. To remove the fan, use a Phillips screw driver to remove the four fan screws to release it.
13. Reverse steps to re-install.

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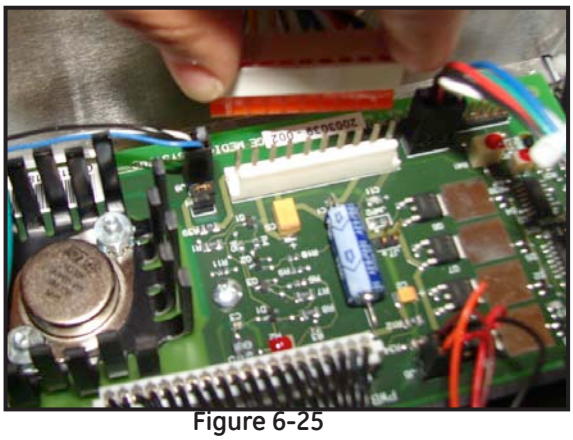

Figure 6-25

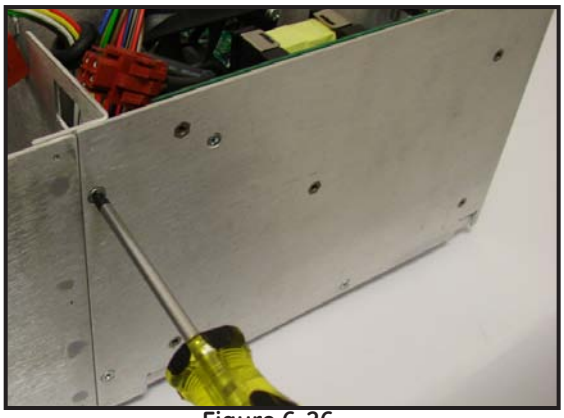

Figure 6-26

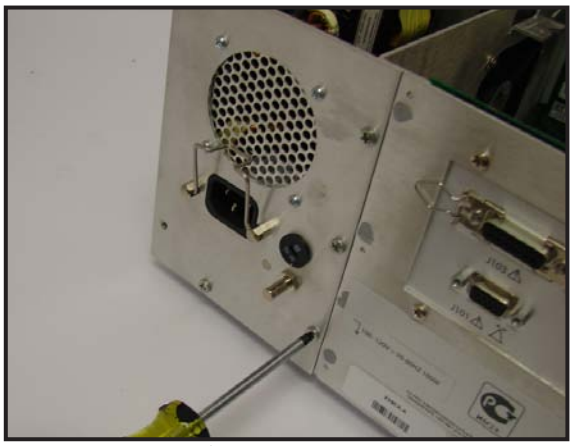

Figure 6-27

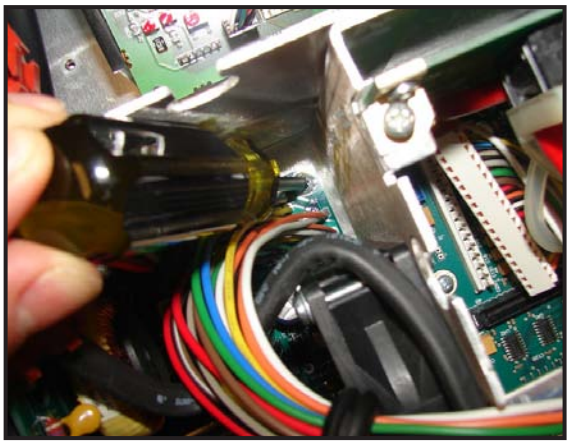

Figure 6-28

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6.12 Dual Ultrasound Board Replacement

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

1. Remove the top cover as instructed in section 6.1.
2. Disconnect the inverter cable from the J1 connector on the DSP/Display board (See Figure 6-3).
3. Disconnect the DSP-to-LCD Decoder ribbon cable from the J2 connector on the DSP/Display board (See Figure 6-4).
4. Use a Phillips screw driver to remove the card cage cover screws and remove the cage cover.
5. Disconnect the ultrasound cables from the connectors on the ultrasound board (See Figure 6-29).
6. Pull up the ultrasound board to release it from the front-end motherboard (See Figure 6-30).
7. Reverse steps to re-install.

NOTE: When re-installing the ultrasound cables, make sure the left-most ultrasound connector (US1) cable is connected to J5 connector (the rear connector on the ultrasound board).

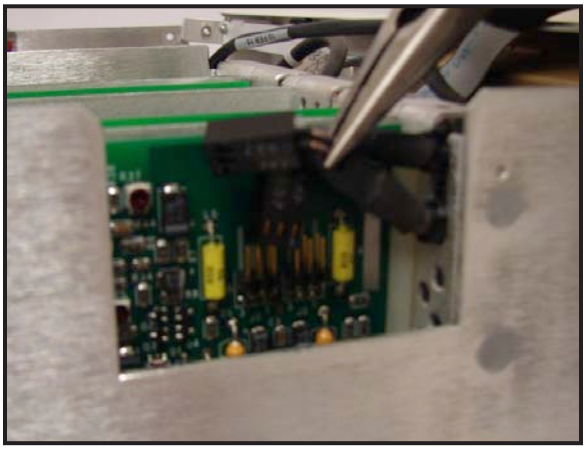

Figure 6-29

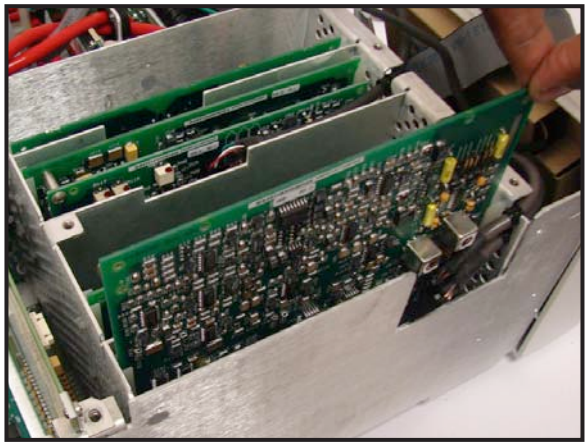

Figure 6-30

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6.13 FECG/UA Board and MECG Board Replacement

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

1. Remove the top cover as instructed in section 6.1.
2. Disconnect the inverter cable from the J1 connector on the DSP/Display board (See Figure 6-3).
3. Disconnect the DSP-to-LCD Decoder ribbon cable from the J2 connector on the DSP/Display board (See Figure 6-4).
4. Use a Phillips screw driver to remove the card cage cover screws and remove the cage cover.
5. If present, disconnect the MECG cable from the connector on the MECG board (See Figure 6-31).
6. Pull out the FECG (and MECG) board(s) (See Figure 6-32). To remove the MECG board, remove the two screws that attach the MECG and FECG boards together.
7. Remove the FECG/UA board.
8. Reverse steps to re-install.

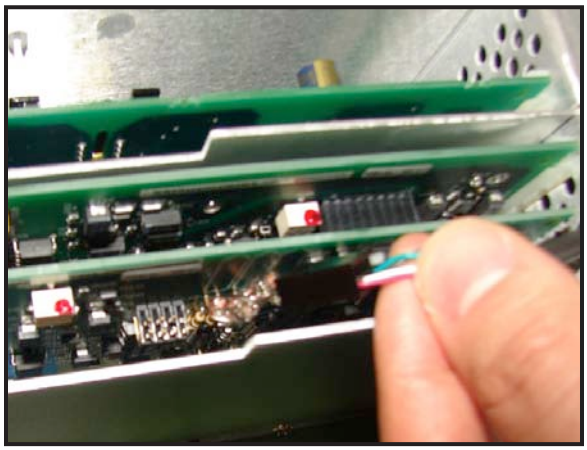

Figure 6-31

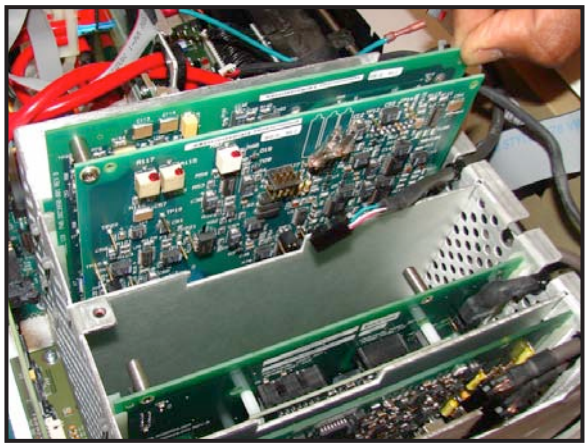

Figure 6-32

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6.14 SpO_2 Carrier Board (with Nellcor/Masimo SpO_2 Module) Replacement

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

1. Remove the top cover as instructed in section 6.1.
2. Disconnect the inverter cable from the J1 connector on the DSP/Display board (See Figure 6-3).
3. Disconnect the DSP-to-LCD Decoder ribbon cable from the J2 connector on the DSP/Display board (See Figure 6-4).
4. Use a Phillips screw driver to remove the card cage cover screws and remove the cage cover.
5. Disconnect the $MSpO_2$ cable from the connector on the SpO_2 Carrier board (See Figure 6-33).

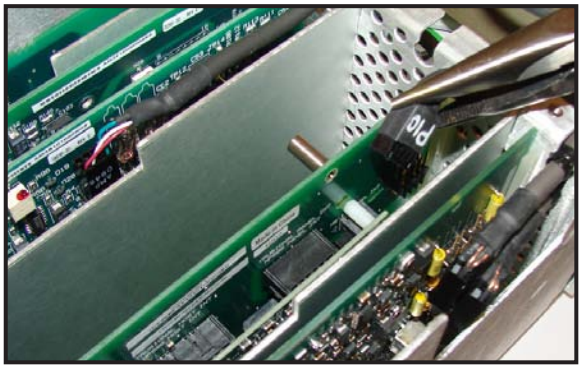

Figure 6-33

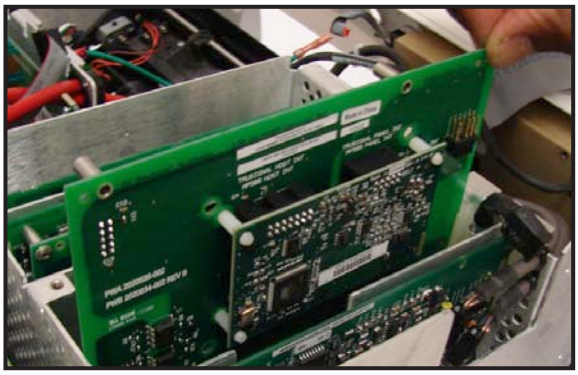

Figure 6-34

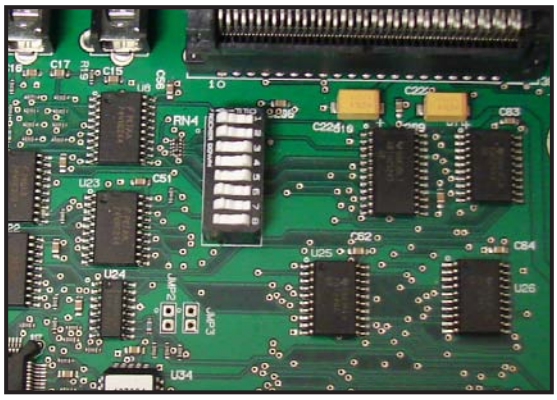

Figure 6-35

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6. Pull up the SpO_2 carrier board with Nellcor/Masimo $MSpO_2$ module assembly to release it from the front-end motherboard (See Figure 6-34).

7. Reverse steps to re-install.

NOTE: If the existing SpO_2 carrier board is replaced with a different SpO_2 board (e.g. Nellcor SpO_2 is replaced with Masimo SpO_2 or vice versa), make sure to set the SW1 dip switches (See Figure 6-35) on the main motherboard properly to select the correct SpO_2 (See Table 1-2). When changing to Masimo SpO_2 , make sure to upgrade the monitor CPU software to version 5.30 to support Masimo MS-2011 (See Appendix F).

6.15 Isolated Power Supply Board Replacement

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

1. Remove the top cover as instructed in section 6.1.

2. Disconnect the inverter cable from the J1 connector on the DSP/Display board (See Figure 6-3).

3. Disconnect the DSP-to-LCD Decoder ribbon cable from the J2 connector on the DSP/Display board (See Figure 6-4).

4. Use a Phillips screw driver to remove the card cage cover screws and remove the cage cover.

5. Pull up the isolated power supply board to release it from the front-end motherboard (See Figure 6-36).

6. Reverse steps to re-install.

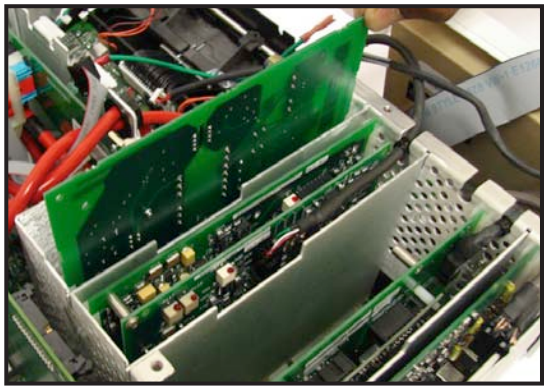

Figure 6-36

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6.16 Front-end Motherboard Replacement

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

1. Remove the top cover and the DSP/Display board as instructed in sections 6.1 and 6.3.
2. Disconnect the inverter cable from the J1 connector on the DSP/Display board (See Figure 6-3).
3. Disconnect the DSP-to-LCD Decoder ribbon cable from the J2 connector on the DSP/Display board (See Figure 6-4).
4. Remove the dual ultrasound board, MECG/FECG board, SpO_2 carrier board, and isolated power supply as instructed in sections 6.12, 6.13, 6.14, and 6.15.
5. Pull up the three insulating metal sheets to release them from the front-end motherboard and remove them from the card cage (See Figure 6-37).
6. Remove the five screws that attach the front-end motherboard to the chassis (See Figure 6-38).
7. Use a Phillips screw driver to remove the two screws (on both sides of the monitor) that attach the front bezel to the chassis (See Figure 6-8).
8. Open the recorder door (When closed, the door will interfere with the bezel movement).
9. Tilt the front bezel forward and away from the chassis (See Figure 6-9).
10. Remove the MECG and FECG cable beads from the chassis bead clips (See Figure 6-39).
11. Disconnect the FECG cable from J6 connector on the front-end motherboard (See Figure 6-40).
12. Disconnect IUP cable from J7 connector on the front-end motherboard (See Figure 6-41).
13. Remove the front-end motherboard.
14. Reverse steps to re-install.

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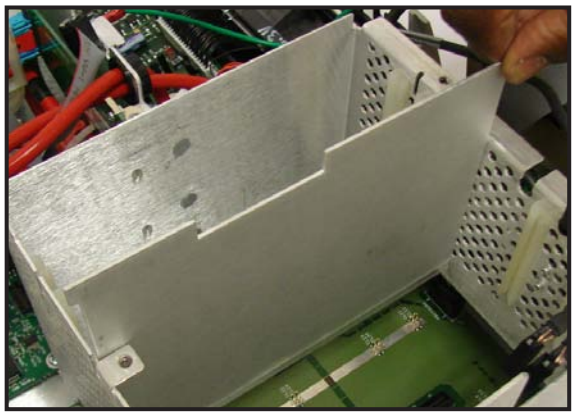

Figure 6-37

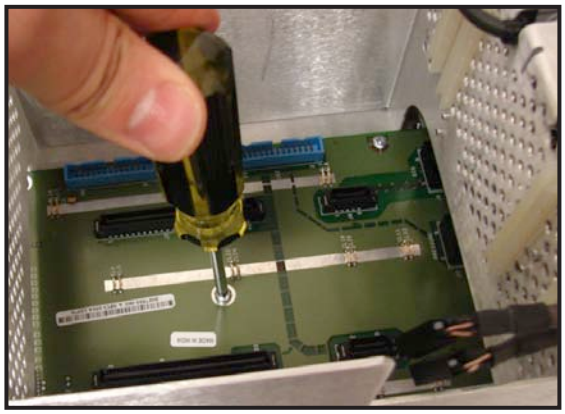

Figure 6-38

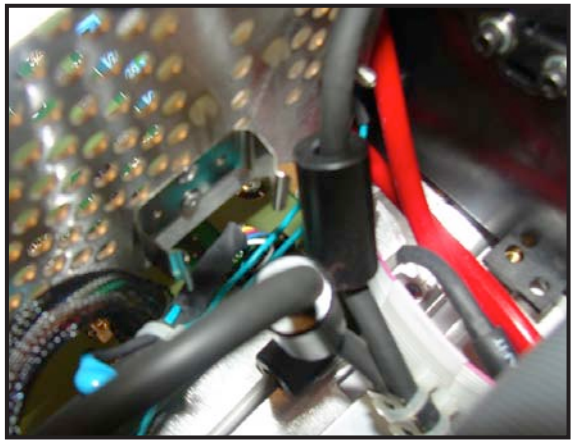

Figure 6-39

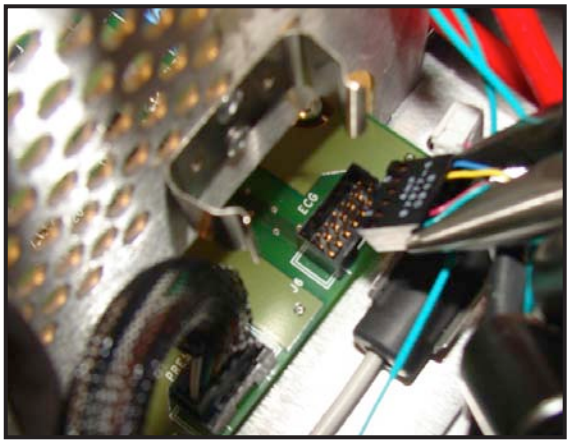

Figure 6-40

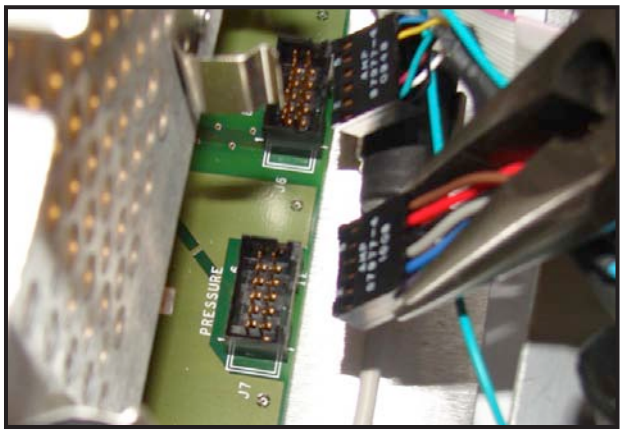

Figure 6-41

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6.17 Recorder Assembly and Recorder Door Button Replacement

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

1. Remove the top cover as instructed in section 6.1.
2. Disconnect the inverter cable from the J1 connector on the DSP/Display board (See Figure 6-3).
3. Disconnect the DSP-to-LCD Decoder ribbon cable from the J2 connector on the DSP/Display board (See Figure 6-4).
4. Disconnect the DSP-to-Keypad ribbon cable from the J5 connector on the DSP/Display board (See Figure 6-5).
5. Use a Phillips screw driver to remove the two screws (on both sides of the monitor) that attach the front bezel to the chassis (See Figure 6-8).
6. Open the recorder door (When closed, the door will interfere with the bezel movement).
7. Tilt the front bezel forward and away from the chassis (See Figure 6-9).
8. Disconnect the recorder ribbon cable from the J2 connector on the recorder board (See Figure 6-42).
9. Disconnect the power supply cable from the J1 connector on the recorder board (See Figure 6-25).
10. Disconnect the recorder EMC ground wire Fast-on connector from the chassis tab (See Figure 6-43).
11. Use a Phillips screw driver to remove four screws that attach the recorder assembly mounting bracket to the chassis (See Figure 6-44).
12. Remove recorder assembly and mounting bracket. Do not snag bracket on hoses or cables while removing.
13. To remove the recorder door button, use a Phillips screwdriver to remove the M3 screw that attaches the button to the recorder latch arm and release the button.
14. Flip over the recorder assembly and use a Phillips screw driver to remove three screws that attach the recorder assembly to the mounting bracket.

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15. Reverse steps to re-install.

NOTE: When re-installing the recorder assembly mounting bracket, do not tighten the four screws until the front bezel is installed. Make sure that the two front bezel fiducial pins are aligned with the recorder slots and the three tabs on the bottom of front bezel are placed into their corresponding slots on the chassis (See Figure 6-45) before tightening the screws.

NOTE: Upon re-installing the recorder board assembly, align the recorder so that it is equidistant from both sides of the printer opening in the front bezel and the recorder door is flush with the outside of the front bezel. Confirm that the recorder door will open and close without interference.

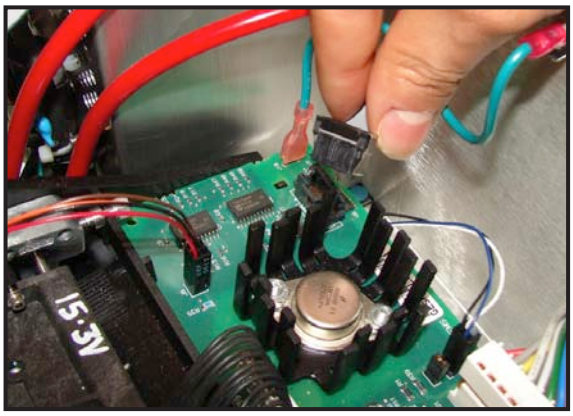

Figure 6-42

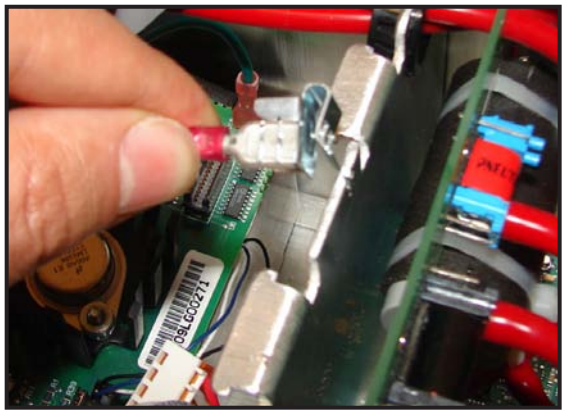

Figure 6-43

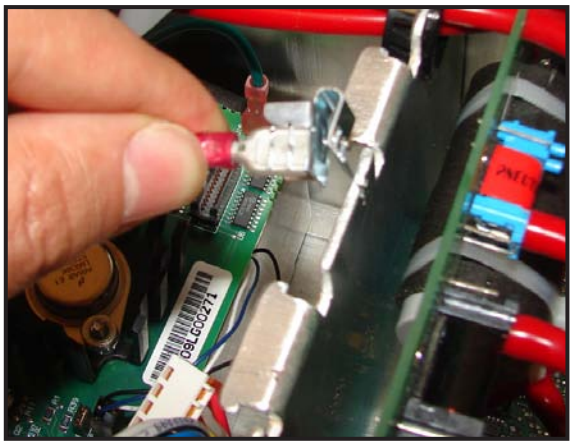

Figure 6-44

Figure 6-45

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6.18 Recorder Board Replacement

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

1. Remove the top cover as instructed in section 6.1.
2. Disconnect the recorder ribbon cable from the J2 connector on the recorder board (See Figure 6-42).
3. Disconnect the power supply cable from the J1 connector on the recorder board (See Figure 6-25).
4. Disconnect the recorder EMC ground wire Fast-on connector from the chassis tab (See Figure 6-43).
5. Disconnect recorder print head cable from the J3 connector on the recorder board (See Figure 6-46).
6. Disconnect the paper-out sensor cable from J6 connector on the recorder board (See Figure 6-47). Make a note of the orientation of the connector for proper re-installation.

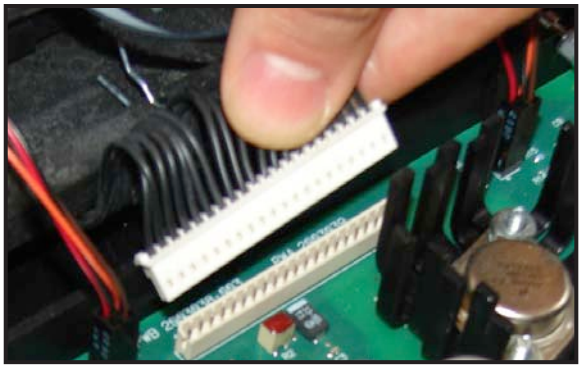

Figure 6-46

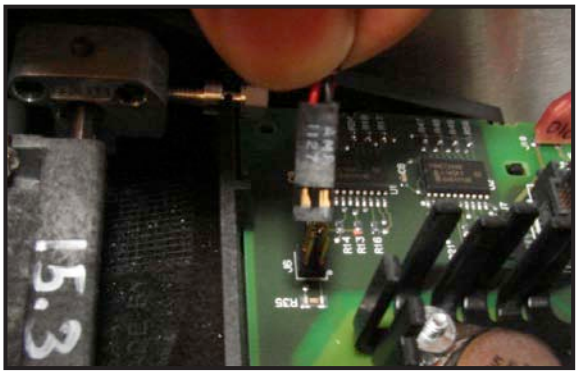

Figure 6-47

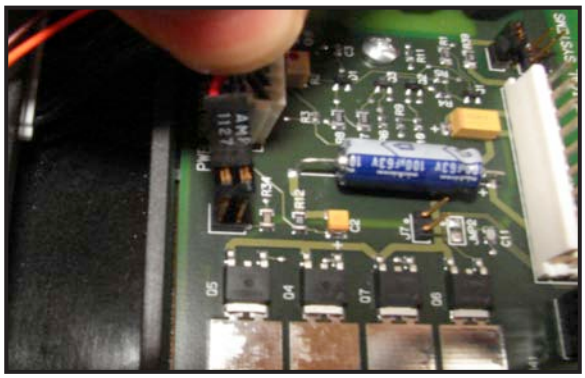

Figure 6-48

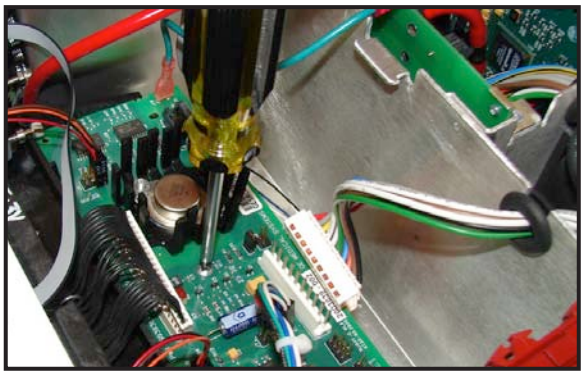

Figure 6-49

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7. Disconnect the paper-low sensor cable from J5 connector on the recorder board (See Figure 6-48). Make a note of the orientation of the connector for proper re-installation.

8. Disconnect recorder paper-loading sensor cable from the J8 connector on the recorder board.

9. Disconnect the stepper motor harness cable from the J4 connector on the recorder board.

10. Use a Phillips screw driver to remove one screw that attach the recorder board to the recorder assembly and remove the recorder board (See Figure 6-49).

11. Reverse steps to re-install.

NOTE: When re-installing paper-low, paper-out, and paper-loading sensor cable connectors to their counterpart connectors (J5, J6, and J8) on the recorder board, make sure the pin 1 of the cable connector (pin 1 is marked on the connector) plugs into the pin 1 of its counterpart connector (pin 1 is marked on the recorder board).

6.19 Recorder Stepper Motor Replacement

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

1. Remove the recorder assembly as instructed in section 6.17.

2. Disconnect the stepper motor harness cable from the J4 connector on the recorder board.

3. Use a Phillips screw driver to loosen the two screws attaching the motor to the frame (See Figure 6-50).

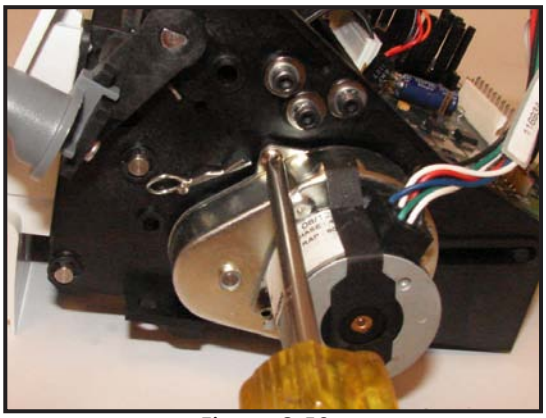

Figure 6-50

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4. Slide the stepper motor out to remove it.

5. Reverse steps to re-install.

6.20 Recorder Paper-Out/Paper-Low Photosensor Replacement

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

Although these two reflective-sensors may be replaced in the field, tight tolerance repositioning is required to ensure that the sensors function properly.

NOTE: When facing the front side of the monitor, the paper-low sensor is on the right side and the paper-out sensor is on the left side (See Figure 7-3)

1. Remove the top cover as instructed in section 6.1.

2. To remove the paper-out photosensor:

    a. Disconnect the paper-out sensor cable from its connector on recorder assembly (See Figure 6-51). Make a note of the orientation of the connector for proper re-installation.

    b. Using a small hex key to remove the two socket-head screws which attach the black sensor housing to the angle bracket (See Figure 6-52).

    c. Discard the sensor and the housing.

3. To remove the paper-low photosensor:

    a. Disconnect the paper-low sensor cable from its connector on the recorder board (See Figure 6-53). Make a note of the orientation of the connector for proper re-installation.

    b. Using a small hex key to remove the two socket-head screws which attach the black sensor housing to the angle bracket (See Figure 6-52).

    c. Discard the sensor and the housing.

4. Reverse steps to re-install.

5. Perform a recorder photosensors check as instructed in section 4.4.2.

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NOTE: When re-installing the sensor housings on to the recorder assembly using the two socket-head screws, make sure that the top of the sensor housing is aligned with the top of the print head bracket (See Figure 6-54) before tightening the screws.

NOTE: When re-installing paper-low and paper-out sensor cable connectors to their counterpart connectors on the recorder assembly, make sure the pin 1 of the cable connector (pin 1 is marked on the connector) plugs into the pin 1 of its counterpart connector (pin 1 is marked on the top of the recorder assembly as illustrated below).

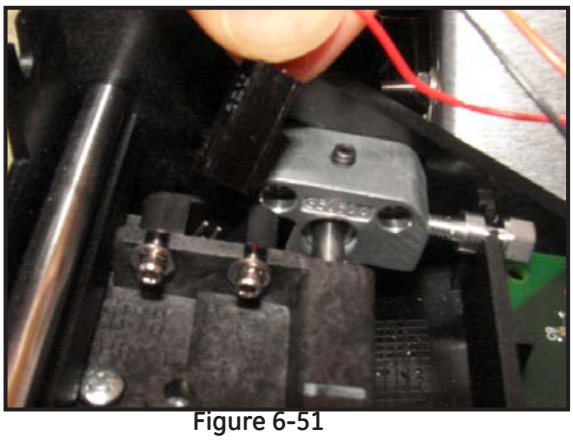

Figure 6-51

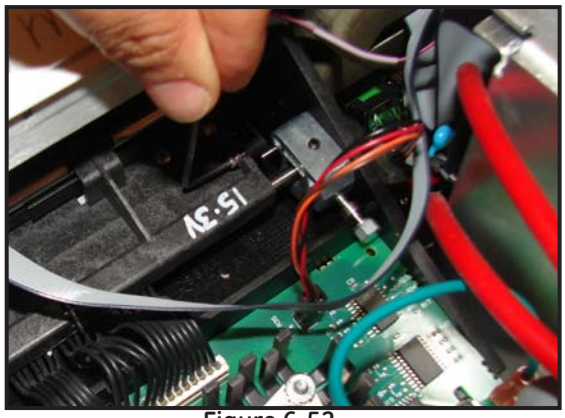

Figure 6-52

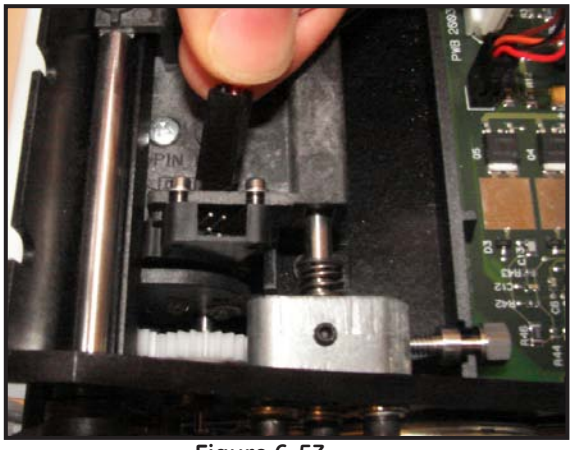

Figure 6-53

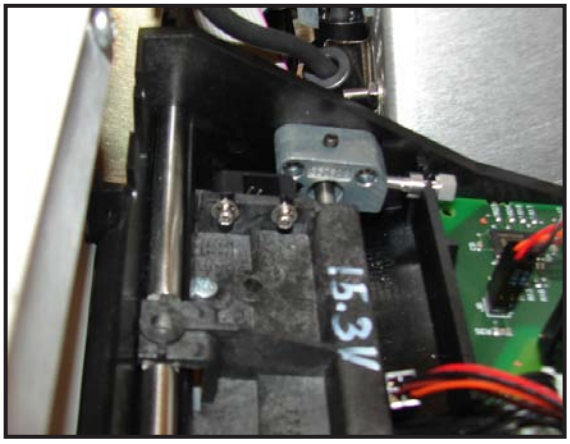

Figure 6-54

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6.21 Recorder Paper-Loading Photosensor Replacement

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

1. Remove the recorder assembly as instructed in section 6.17.
2. Disconnect recorder paper-loading sensor cable from the J8 connector on the recorder board.
3. Turn over the recorder and use a Phillips screwdriver to remove the two screws which hold the sensor and housing to the paper tray (See Figure 6-55).
4. Cut and remove the cable tie which holds the sensor cable.
5. Discard the sensor and printed circuit board.
6. Reverse steps to re-install.
7. Perform a recorder photosensors check as instructed in section 4.4.2.

NOTE: When re-installing the paper-loading sensor, make sure that there is enough slack in the cable so that when the recorder door is opened the cable does not become taut.

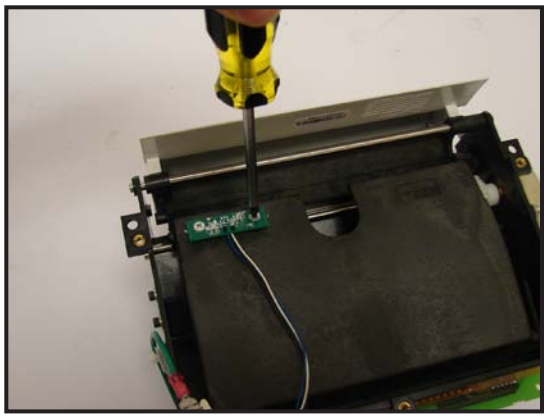

Figure 6-55

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6.22 Recorder Thermal Print Head Replacement

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

1. Remove the top cover as instructed in section 6.1.
2. Disconnect recorder print head cable from the J3 connector on the recorder board (See Figure 6-46).
3. Open the recorder door.
4. Use a Pillips screw driver to remove the two screws that attach the printer frame to the print head (See Figure 6-56).
5. Support the print head by reaching in through the recorder door, then remove the two screws on top of the print head.
6. Pull the print head down and out through the recorder door with the harness still attached.

NOTE: When pulling out the print head, make sure that the four pressure springs are held captive and they do not fall out.

7. Remove the harness cable from the print head.

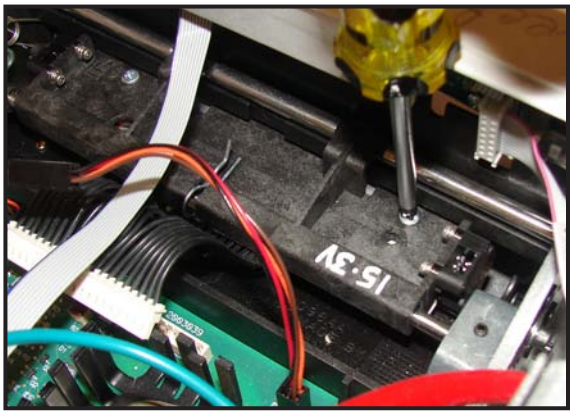

Figure 6-56

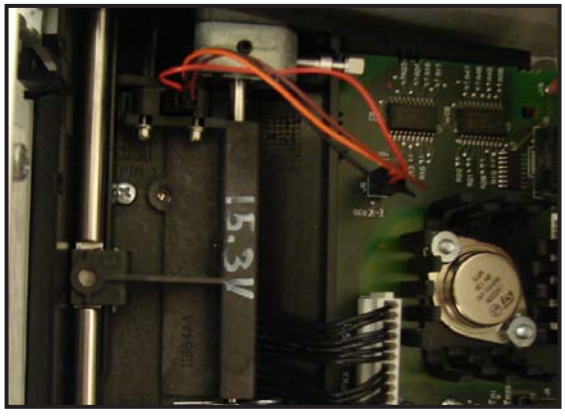

Figure 6-57

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8. Follow below steps to re-install a new thermal print head:

    a. Carefully remove the new print head from the packaging. DO NOT TOUCH any of the contact pins.

    b. Record the voltage rating marked on the decal affixed to the bottom of the print head. This value is the new VHEAD voltage. Cross out the old VHEAD voltage (already marked on the print head bracket) and mark the new VHEAD voltage on the bracket (See "15.3V" example in Figure 6-57).

    c. Re-connect the harness cable to the new print head.

    d. Slide the new print head into position through the recorder door and under its bracket. Push on the center of the new print head to ensure it is pushed all the way back.

    e. Align the new print head with the front holes in the bracket and re-install the two screws.

    f. Re-connect the harness cable to the recorder board at J3.

    g. Set a multimeter to measure DC voltage. Connect the positive lead of the multimeter to pin 4 of J6 on the recorder board and connect the negative lead to pin 4 of J5 connector on the recorder board.

    h. Turn on the monitor.

    i. Press the record button to turn on the recorder.

    j. Adjust R2 on the recorder board until the reading on the multimeter is within ±100 mV of the new VHEAD voltage.

    k. Use the Trim Knob Control to go to *Install Options Screen 1* screen and access the *Diagnostic Control* screen and perform the recorder calibration test to confirm the printing and adjustment of vertical lines. If light printing occurs, perform horizontal offset adjustment as instructed in section 5.11.2.

    l. Re-install the top cover.

6.23 Front Bezel Replacement

SENSITIVE TO ELECTROSTATIC DISCHARGE

This procedure includes ESD sensitive parts. ESD control guidelines must be followed during this procedure to ensure that static charges are safely conducted to the ground and not through the sensitive device, to prevent damage to the equipment.

1. Remove the top cover as instructed in section 6.1.

2. Disconnect the inverter cable from the J1 connector on the DSP/Display board (See Figure 6-3).

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3. Disconnect the DSP-to-LCD Decoder ribbon cable from J2 connector on the DSP/Display board (See Figure 6-4).
4. Disconnect the DSP-to-Keypad ribbon cable from J5 connector on the DSP/Display board (See Figure 6-5).
5. Use a Phillips screw driver to remove the two screws (on both sides of the monitor) that attach the front bezel to the chassis (See Figure 6-8).
6. Open the recorder door (When closed, the door will interfere with the bezel movement).
7. Tilt the front bezel forward and away from the chassis (See Figure 6-9).
8. Use a Phillips screw driver to remove the card cage cover screws and remove the cage cover.
9. Disconnect the ultrasound cables from the connectors on the ultrasound board (See Figure 6-29).
10. If present, disconnect the MECG cable from the connector on the MECG board (See Figure 6-31).
11. Disconnect the $MSpO_2$ cable from the connector on the SpO_2 Carrier board (See Figure 6-33).
12. Remove the MECG and FECG cable ferrite beads from the chassis bead clips (See Figure 6-39).
13. Remove the $MSpO_2$ cable ferrite beads from the chassis bead clips.
14. Remove the FECG ground cable from the chassis post by removing its nut.
15. Disconnect the FECG cable from J6 connector on the front-end motherboard (See Figure 6-40).
16. Disconnect IUP cable from J7 connector on the front-end motherboard (See Figure 6-41).
17. Disconnect the two red pneumatics tubes from front-bezel NIBP connector (See Figure 6-10).
18. Remove the display assembly as instructed in section 6.7.
19. Remove the keypads as instructed in section 6.10.
20. Remove the trim knob control and the encoder as instructed in section 6.9.
21. Remove the power switch as instructed in section 6.8.
22. Remove front bezel from chassis tabs.
23. Reverse steps to re-install.

NOTE: When re-installing the ultrasound cables, make sure the left-most ultrasound connector (US1) cable is connected to J5 connector (the rear connector on the ultrasound board).

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Chapter 7: Service Parts

This chapter illustrates the Corometrics™ 250cx Series monitor service parts and includes the orderable service kit part numbers. A complete Field Replaceable Unit (FRU) list is also provided.

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7.1 Illustrated Parts

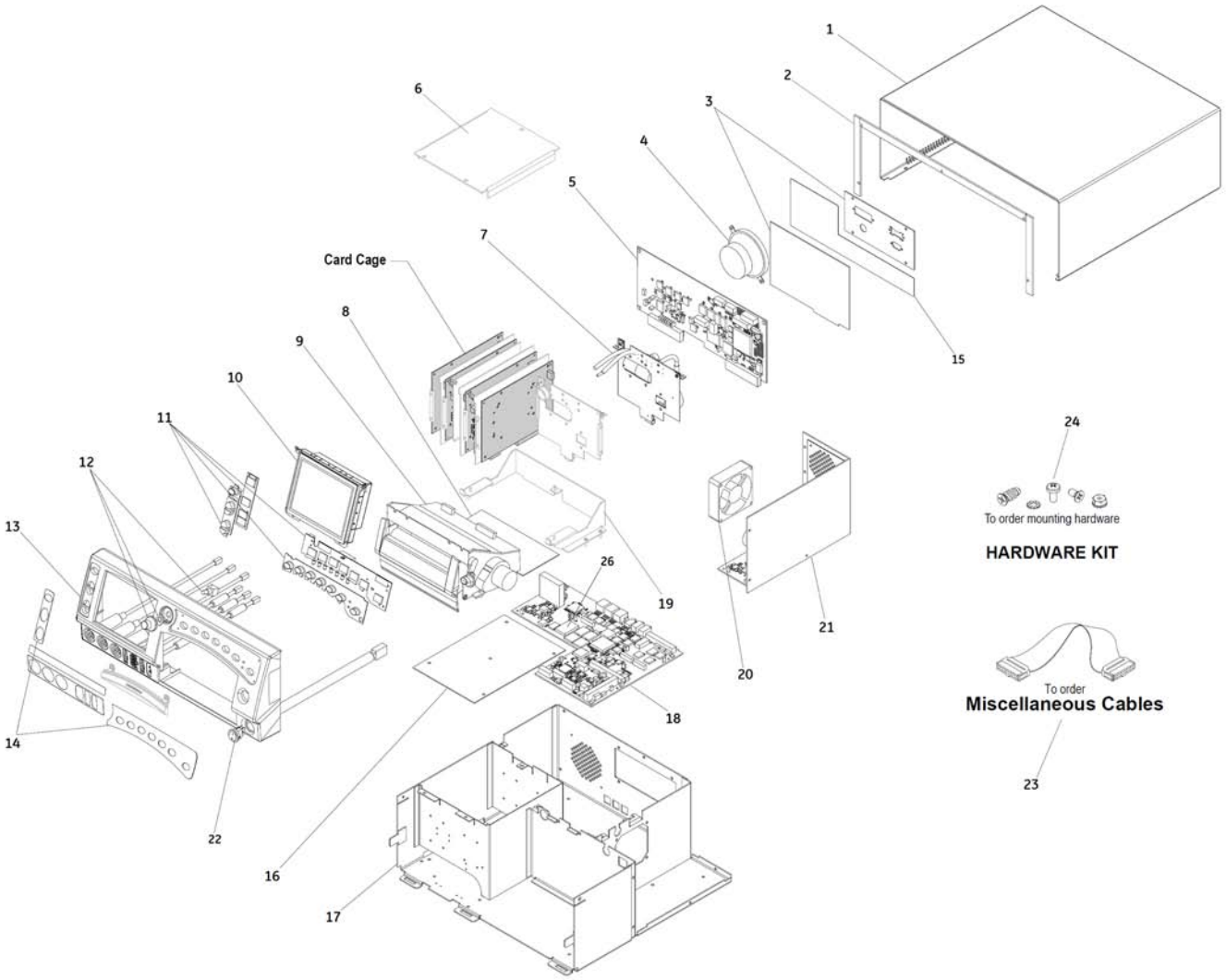

Figure 7-1 Exploded View

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Callout	Part Description	Orderable Service Kit Number	Orderable Service Kit Description
1	Top cover	2025177-030	Top cover FRU
2	Top cover gasket	2025177-031	Top cover gasket FRU
3	Communication board with plate	2025177-070	Communication board with plate FRU
4	Speaker	2025177-003	Speaker FRU
5	DSP board	2025177-077	DSP Board FRU
6	Cage cover	Non-Orderable	Not applicable
7	Pneumatics board	2025177-020	Pneumatics board FRU
8	Recorder board	2025177-072	Recorder board FRU*
9	Recorder assembly	2025177-071	Recorder assembly FRU**
10	Display assembly	2025177-076	Display FRU
11	Keypad/Volume pad	2025177-073	Keypad/Volume pad FRU
12	Trim knob control and switch	2025177-026	Trim knob control and switch FRU
13	Front bezel with cables	2025177-082	Front bezel with cables FRU***
14,15	Front panel labels, Rear panel labels	2025177-034	Label FRU kit, English (US)
		2025177-059	See section 7.2 for descriptions of language-specific label FRU kits.
		2025177-060	
		2025177-061	
16	Frond-end motherboard	2025177-069	Frond-end motherboard FRU
17	Chassis	Non-Orderable	Not applicable
18	Main board	2025177-078	Main board FRU
19	Recorder mounting bracket	Non-Orderable	Not applicable
20	Fan	2025177-006	Fan FRU
21	Main power supply	2025177-074	Main power supply FRU
22	Power switch assembly	2025177-027	Power switch assembly FRU
23	Miscellaneous Cables	2025177-019	Cables FRU
24	Screws, washers, spacers	2025177-002	Hardware FRU kit
25	Power cord holder (P-clamp)	2025177-054	Power cord holder FRU
26	Timekeeping RAM chip (U30)	414775-001	Timekeeping RAM chip

* For all Coro 250cx units that were manufactured prior to January 29, 2010, i.e. unit serial numbers before SDJ10054541PA, order an additional service kit (print head cable FRU kit, Part number: 2025177-042, which contains the new recorder cable and print head) and follow instruction included in the kit to replace the print head thermal and the recorder cable whenever you order the recorder board FRU (PN: 2025177-072 -FRU CORO250) to replace the recorder board.
The new recorder board and new recorder cable/print head must also be ordered and installed whenever there is a need to replace the old version of recorder print head/cable in a unit.

**FRU kit does not include the mounting bracket.

*** The NIBP socket on the front bezel is also separately orderable through NIBP socket replacement kit (Part number: 2025177-046).

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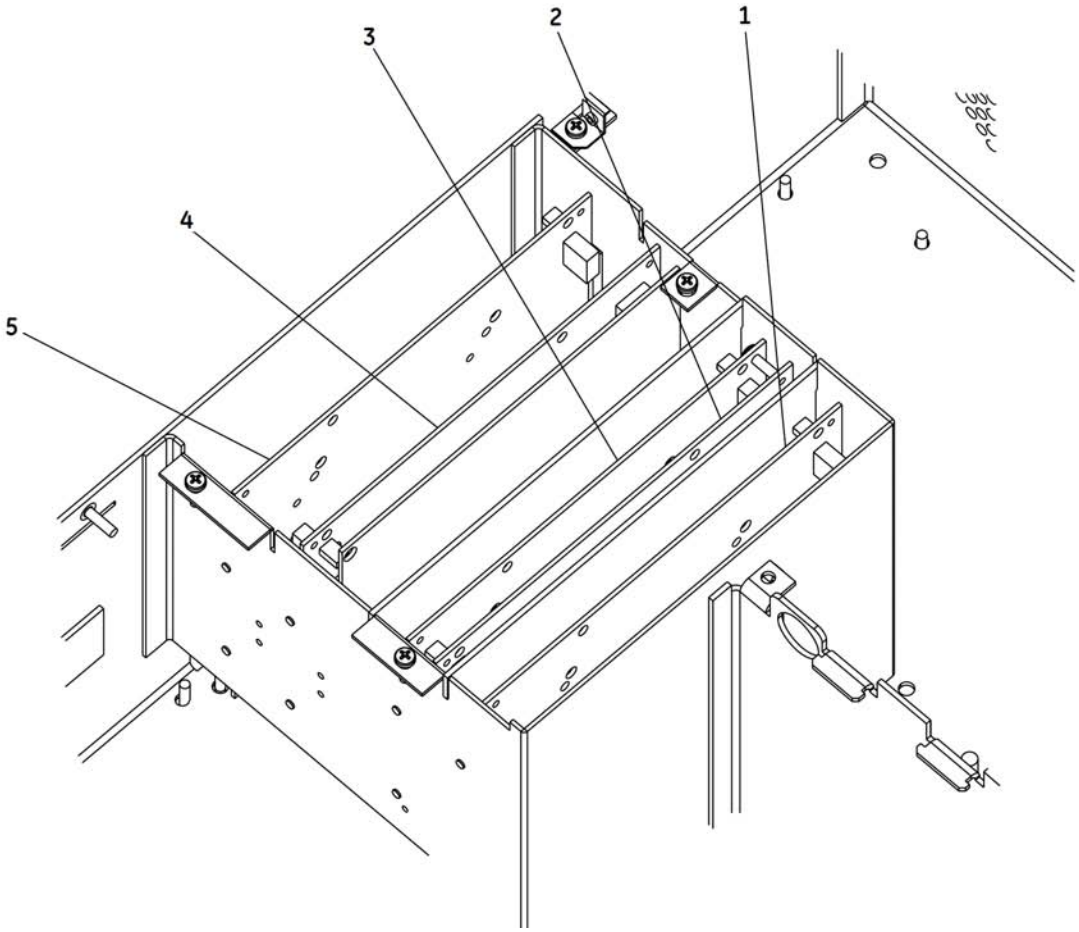

Figure 7-2 Card Cage Boards

Callout	Part Description	Orderable Service Kit Number	Orderable Service Kit Description
1	Isolated power supply board	2025177-066	Isolated power supply board FRU
2	FECG/UA board	2025177-065	FECG/UA board FRU
3	MECG board	2025177-075	MECG board FRU
4	SpO_2 carrier board with oximetry*	2025177-010	SpO_2 carrier board with Nellcor oximetry FRU
		2025177-011	SpO_2 carrier board with Masimo (MS-2011) oximetry FRU
5	Dual ultrasound board	2025177-064	Dual ultrasound FRU

* To replace MASIMO SpO_2 with NELLCOR SpO_2 in a Corometrics™ 250CX Series monitor, order the relevant replacement kit (Part Number: 2025177-044).

To replace NELLCOR SpO_2 with MASIMO SpO_2 in a Corometrics™ 250CX Series monitor, please order the relevant replacement kit (Part Number: 2025177-043).

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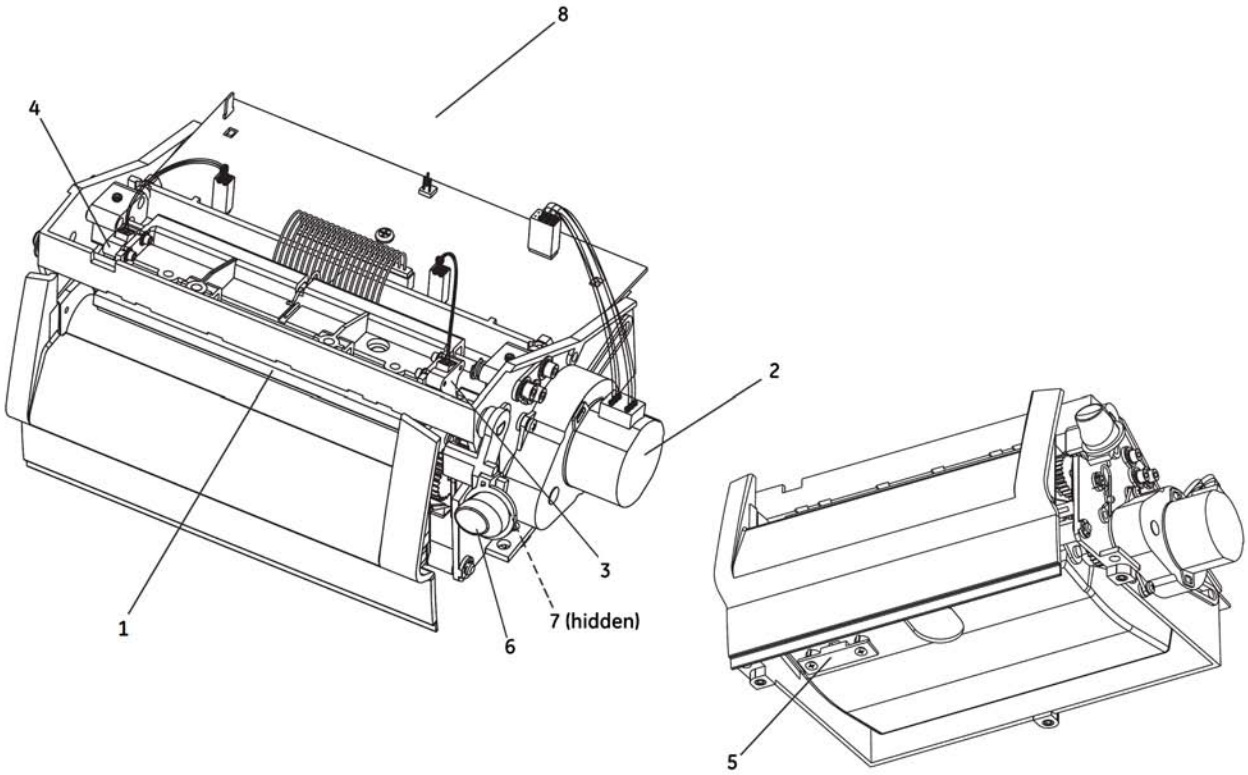

Figure 7-3 Recorder

Callout	Part Description	Orderable Service Kit Number	Orderable Service Kit Description
1	Recorder thermal print head	2025177-056	Recorder thermal print head FRU
2	Recorder stepper motor	2025177-057	Recorder stepper motor FRU
3	Recorder paper-low photosensor	2025177-058	Recorder photosensors FRU
4	Recorder paper-out photosensor		
5	Recorder paper-load photosensor		
6	Recorder door button	2025177-047	Recorder door button FRU
7	M3x12 Phillips screw	2025177-047	Recorder door button FRU
8	Recorder assembly	2025177-071	Recorder assembly FRU

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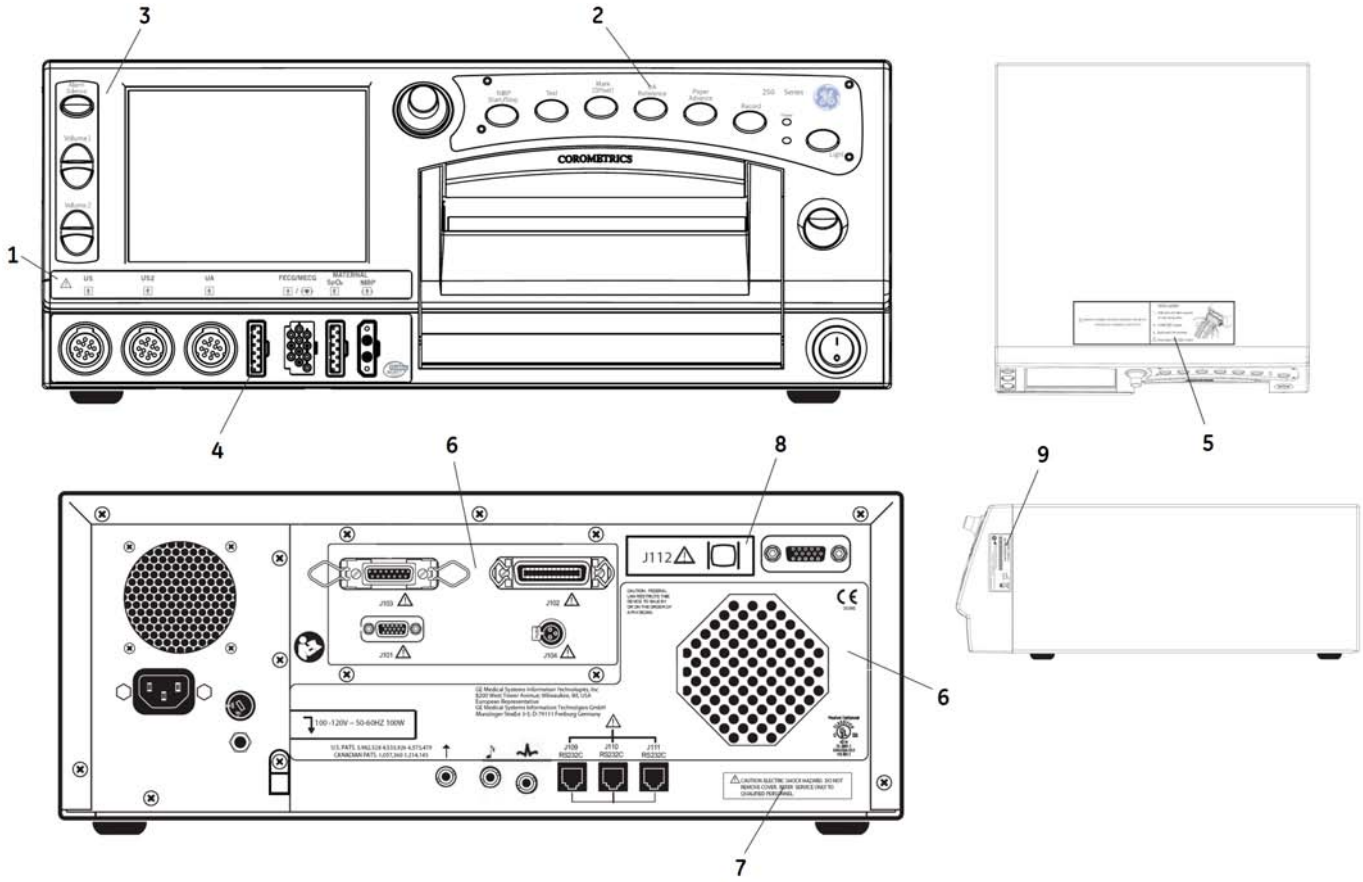

Figure 7-4 Labels

Callout	Part Description	Orderable Service Kit Number	Orderable Service Kit Description
1	Connectors label	See section 7.2	Labels FRU Kit (Language-specific)
2	Main keypad label		
3	Volume pad label		
4	Masimo/Nellcor overlay label		
5	Paper loading label		
6	Rear panel label		
7	Electrical shock hazard label		
8	VGA connector label		
9	Serial number label	Non-Orderable	Not applicable

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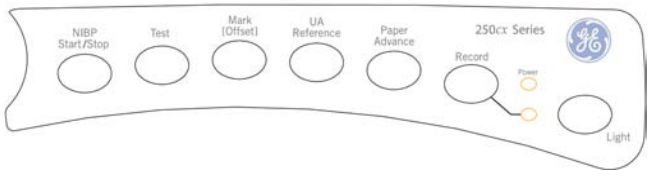
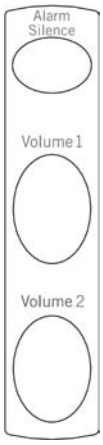
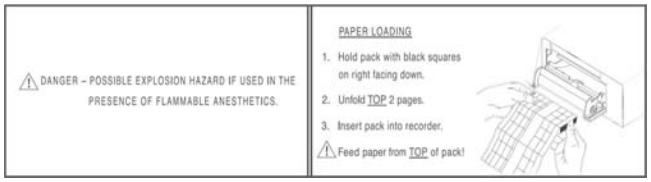
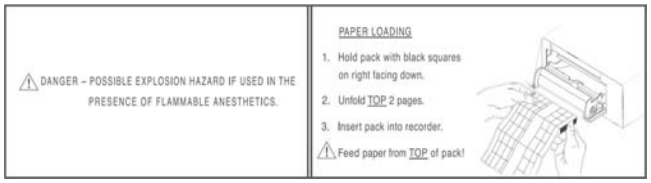
7.2 Labels

This section includes the list of product labels. For the location of each label, refer to Figure 7-3.

NOTE: The following labels shown are for illustration purposes only. The content on the labels shown here may be slightly different from the content of the actual labels on the system.

Label Image	Label Name	Orderable Service Kit Number	Orderable Service Kit Description
	Connectors label	See the NOTE below this table.	Labels FRU Kit (Language-specific)
	Main keypad label		
	Volume pad label		
	Paper loading label		
	Paper loading label		

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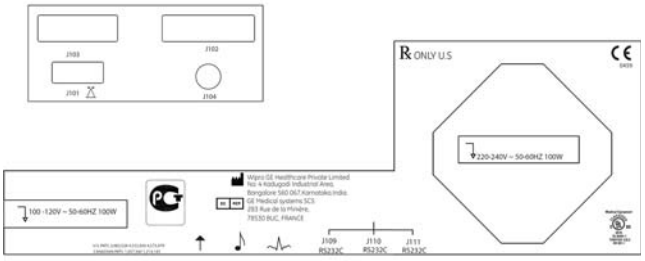
Label Image	Label Name	Orderable Service Kit Number	Orderable Service Kit Description
	Rear panel label		
CAUTION: ELECTRIC SHOCK HAZARD. DO NOT REMOVE COVER. REFER SERVICE ONLY TO QUALIFIED PERSONNEL.	Electrical shock hazard label		
J112	VGA connector label		
	Serial number label	Non-Orderable	Not applicable

NOTE: Use below part numbers to order the language-specific label FRU kits:

2025177-034 : Label FRU Kit, English (US)
2025177-059 : Label FRU Kit, Lang 4 (Czech, Greek, Indonesian, Lithuanian, Portuguese, Turkish)
2025177-060 : Label FRU Kit, Lang 3 (Danish, Dutch, French, German, Japanese, Spanish)
2025177-061 : Label FRU Kit, Lang 2 (Finnish, Italian, Norwegian, Polish, Russian, Swedish)

7.3 Power Cords

Power Cord Part Number	Power Cord Description
2027249-021	Power cord - USA (IEC)
2027249-022	Power cord - ANZ
2027249-023	Power cord - UK
2027249-024	Power cord - EUR
2037556-034	Power cord - China
2037556-035	Power cord - Japan
2037556-036	Power cord - Denmark
2037556-037	Power cord - India
2037556-044	Power cord - Brazil

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7.4 FRU List

Part Number	Part Description	QTY
2025177-002	**Hardware FRU Kit**	
	BRACKET , GROUNDING PLATE	*[1]*
	BRACKET , PRINTER SUPPORT, 120 V4	*[1]*
	BRACKET 120 SERIES V4	*[1]*
	BRACKET MTG 120 SERIES V4	*[1]*
	BUSHING INSULATOR SNAP	*[1]*
	CABLE,TIE MOUNT,3/4IN,ADH,.BACK	*[1]*
	CLIP EMI 4 PRONGS	*[2]*
	GROUND WIRE ASSEMBLY	*[1]*
	JACKSOCKET,4-40,.312LG,	*[1]*
	NUT, M3.5 HEX, STL ZN, DIN 934	*[5]*
	PLUG TELEMETRY COROLITE	*[1]*
	SCR ,M3.5X10, PNHD, PHH, STL ZN DIN 7985	*[12]*
	SCR ,M3X8 PHH PNHD,STL ZN, PT TYPE	*[4]*
	SCR M3.5X30 PH PHD STL ZN DIN 7985 DRILO	*[4]*
	SCR M3.5X6 PH PHD STL ZN DIN 7985 DRILOC	*[4]*
	SCR M3.5X8 PH FHD STL ZN DIN 965A DRILOC	*[5]*
	SCR M3.5X8 PH PHD STL ZN DIN 7985 DRILOC	*[24]*
	SCR M3X12 PH PHD STL ZN DIN 7985 DRILOC	*[1]*
	SCR M3X5 PH PHD STL ZN DIN 7985 DRILOC	*[2]*
	SCR M3X6 PH PHD STL ZN DIN7985 DRILOC	*[21]*
	SCR M3X8 PH PHD STL ZN DIN 7985 DRILOC	*[4]*
	SCR,4-40,BH,1/4 LG,SLTD,N,YLON	*[2]*
	SCR,4-40,PH,1/4L,PHL,LL S,TRIP	*[2]*
	SCR,6-32,PH,3/8L,PHL,LL S,TRIP	*[4]*
	SCR,6-32,PH,5/16L,PHL,LL,STRIP	*[5]*
	SPACER PCB STAND OFF	*[3]*
	SPACER PCB STAND OFF	*[4]*
	TIE WRAP 4.00LG X .10W	*[2]*
	TUBING SILICONE CLEAR 3/32" ID 7/32" OD	*[0.29 ft]*
	TUBING SILICONE RED 1/8"ID X 1/4"OD	*[3.9 ft]*
	TYRAPS,CABLE TIES	*[1]*
	WSHR , M3.5 FLAT, STL ZN, DIN 125A	*[8]*
	WSHR NYLON 10MM OD, 4.1MM ID, 4.5MM THK	*[2]*

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Part Number	Part Description	QTY
2025177-003	**Speaker FRU Kit**	
	Speaker assembly (Wire and connector included)	*[1]*
2025177-006	**Fan FRU Kit**	
	Fan assembly (connector included)	*[1]*
2025177-064	**Dual Ultrasound Board FRU Kit**	
	Dual ultrasound board	*[1]*
2025177-065	**FECG/UA Board FRU Kit**	
	FECG/UA board	*[1]*
2025177-066	**Isolated Power Supply Board FRU Kit**	
	Isolated power supply board	*[1]*
2025177-010	**SpO_2 Carrier Board with Nellcor FRU Kit**	
	SpO_2 carrier board with Nellcor SpO2 board	*[1]*
2025177-011	**SpO_2 Carrier Board with Masimo FRU Kit**	
	SpO_2 carrier board with Masimo (MS-2011) SpO2 board	*[1]*
	SpO_2 connector board (for bezel)	*[1]*
	Coro250/250cx software upgrade V2.3.0 CD	*[1]*
	FM I/C cable for flying config Coro150 series	*[1]*
	Masimo MS11 to MS-2011 upgrade instruction sheet	*[1]*
2025177-069	**Frond-end Motherboard FRU Kit**	
	Front-end motherboard assembly	*[1]*
2025177-070	**Communication Board with Plate FRU Kit**	
	Communication board assembly (Panel included)	*[1]*
2025177-071	**Recorder Assembly FRU Kit**	
	Recorder assembly (Recorder board, photosensors, and stepper motor included)	*[1]*
2025177-072	**Recorder Board FRU Kit**	
	Recorder board assembly	*[1]*
	PCB insulating sheet	*[1]*
2025177-019	**Cables FRU Kit**	
	Recorder cable assembly	*[1]*
	DSP-to-Keypad ribbon (5 cond.) cable assembly	*[1]*
	Ribbon (14 pin) cable assembly	*[1]*
	DSP-to-LCD ribbon (20 cond.) cable assembly	*[1]*
	DSP-to-LCD ribbon (30 cond.) cable assembly	*[1]*
	DSP-to-Inverter (8 cond.) cable assembly	*[1]*
	VGA cable assembly	*[1]*
2025177-020	**Pneumatics Board FRU Kit**	
	NIBP pneumatics board assembly (pump and silicon tubings included)	*[1]*
	NIBP board assembly installation instruction sheet	*[1]*

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Part Number	Part Description	QTY
2025177-082	**Front Bezel with Cables FRU Kit**	
	Front bezel assembly (Ultrasound, ECG, UA, SpO_2 cable assemblies and sockets plus NBP socket and display lens included)	*[1]*
2025177-073	**Keypad/Volume Pad FRU Kit**	
	Main user interface PCB assembly	*[1]*
	Keyboard pad, side	*[1]*
	Keyboard pad, main	*[1]*
2025177-026	**Trim Knob Control and Switch FRU Kit**	
	Trim Knob	*[1]*
	Encoder, optical, pushbutton, 16 POS	*[1]*
	Washer, encoder, non-turn	*[1]*
2025177-027	**Power Switch Assembly FRU Kit**	
	Power switch assembly (wires, terminals and contacts included)	*[1]*
2025177-074	**Main Power Supply FRU Kit**	
	Power supply	*[1]*
	Cable, tie mount	*[1]*
	Cable ties, tyraps	*[1]*
2025177-075	**MECG Board FRU Kit**	
	MECG board	*[1]*
2025177-030	**Top Cover FRU Kit**	
	Cover	*[1]*
	Gasket, Left	*[1]*
	Gasket, Top	*[1]*
	Gasket, Right	*[1]*
	Screw M3.5x8, PH, STL	*[7]*
	Screw, 6-32, PH, STRIP	*[2]*
2025177-031	**Top Cover Gasket FRU Kit**	
	Tape, Foam 4508 0.5IN x 36YDS	*[1]*
2025177-076	**Display FRU Kit**	
	Display assembly (Mounting bracket, display cover and cables included)	*[1]*
	Display lens	*[1]*
2025177-077	**DSP Board FRU Kit**	
	DSP/Display board assembly	*[1]*
2025177-034	**Labels FRU Kit, English (US)**	
	Connector label	*[1]*
	Main keypad label	*[1]*
	Volume pad label	*[1]*
	Paper loading label	*[1]*

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Part Number	Part Description	QTY
	Rear panel label	*[1]*
	Electrical shock hazard label	*[1]*
	VGA connector label	*[1]*
	Coro259 Masimo overlay label	*[1]*
	Coro259 Nellcor overlay label	*[1]*
2025177-078	**Main Board FRU Kit**	
	Main board assembly	*[1]*
2025177-042	**Print Head Cable FRU Kit**	
	Recorder thermal print head	*[1]*
	Recorder print head cable assembly	*[1]*
2025177-043	**Nellcor to Masimo SpO_2 Upgrade Kit**	
	SpO_2 carrier board with Masimo (MS-2011) SpO_2 board	*[1]*
	SpO_2 connector board (for bezel)	*[1]*
	Coro250/250cx software upgrade V2.3.0 CD	*[1]*
	FM I/C cable for flying config Coro150 series	*[1]*
	Nellcor To Masimo label	*[1]*
	Coro259 Masimo overlay label	*[1]*
	Nellcor to Masimo MS-2011 upgrade instruction sheet	*[1]*
2025177-044	**Masimo to Nellcor SpO_2 Upgrade Kit**	
	SpO_2 carrier board with Nellcor SpO_2 board	*[1]*
	Masimo To Nellcor label	*[1]*
	Coro259 Nellcor overlay label	*[1]*
	Masimo to Nellcor upgrade instruction sheet	*[1]*
2025177-046	**NIBP Connector FRU Kit**	
	NBP Socket	*[1]*
	NBP Connector replacement instruction sheet	*[1]*
2025177-047	**Recorder Door Button FRU Kit**	
	Recorder door button	*[1]*
	M3x12 Phillips screw	*[1]*
2025177-054	**Power Cord Holder FRU Kit**	
	Power cord holder (P-clamp)	*[5]*
	M3.5 X 8 Phillips Screw	*[5]*
	M3.5 Washer	*[5]*
2025177-055	**ECG Cables FRU Kit**	
	FECG simulation cable	*[1]*
	MECG simulation cable	*[1]*

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Part Number	Part Description	QTY
2025177-056	**Recorder Thermal Print Head FRU Kit**	
	Thermal print head	*[1]*
	M3 x 5 Phillips Screw	*[2]*
2025177-057	**Recorder Stepper Motor FRU Kit**	
	Stepper motor assembly	*[1]*
	4-40 Phillips Screw	*[2]*
2025177-058	**Recorder Photosensors FRU Kit**	
	Paper-low photosensor assembly	*[1]*
	Paper-out photosensor assembly	*[1]*
	Paper-load photosensor assembly	*[1]*
2025177-059/060/061	**Label FRU Kit, Lang 4/Lang 3/Lang 2**	
	Connector IEC label, Coro250cx, Lang 4/Lang 3/Lang 2	*[1]*
	Connector IEC label, Coro256cx, Coro250cx, Lang 4/Lang 3/Lang 2	*[1]*
	Main keypad label, Lang 4/Lang 3/Lang 2	*[1]*
	Volume pad label, Lang 4/Lang 3/Lang 2	*[1]*
	Paper loading label, Lang 4/Lang 3/Lang 2	*[1]*
	Rear panel label	*[1]*
	Electrical shock hazard label, Lang 4/Lang 3/Lang 2	*[1]*
	VGA connector label Coro259 Masimo overlay label	*[1]*
	Coro259 Masimo overlay label	*[1]*
	Coro259 Nellcor overlay label	*[1]*
	Coro 256 Overlay Label	*[1]*
414775-001	**Timekeeping RAM Chip**	
	Timekeeping RAM Chip	*[1]*

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Appendix A: Technical Specifications

This section contains the list of the technical specifications for the Corometrics™ 250cx Series monitors.

NOTE: Specifications are subject to change without notice.

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A.1 General Product Specifications

General Product Specifications		
Category	**Specifications**	
Power Requirements		
Nominal Line Voltage:	100VAC 120 VAC 220 VAC 230 VAC 240 VAC	
Line Frequency:	50/60 Hz 50/60 Hz 50/60 Hz 50/60 Hz 50/60 Hz	
Power Consumption (maximum):	100 W 100 W 0.4 A 0.4 A 0.4 A	
Chassis Leakage:	<300 µA	
Physical Characteristics		
Height:	6.7 in (17.0 cm)	
Width:	16.7 in (42.4 cm)	
Depth:	17.5 in (44.4 cm)	
Weight:	22.0 lbs (10.9 kg) approx.	
Environmental Conditions	**Operating**	**Storage**
Monitor:		
Ambient Temperature:	50°F to 104°F (10°C to 40°C)	14°F to 131°F (–10°C to 55°C)
Relative Humidity:	10% to 95%, non-condensing	0% to 95%, non-condensing
Atmospheric Pressure:	700–1060 mbar (525–795 mmHg)	700–1060 mbar (525–795 mmHg)
Strip Chart Paper[1]:		
Ambient Temperature:	50°F to 104°F (10°C to 40°C)	< 80°F (< 26.5°C)
Relative Humidity:	30% to 70%, non-condensing	45% to 65%, non-condensing
Atmospheric Pressure:	700–1060 mbar (525–795 mmHg)	700–1060 mbar (525–795 mmHg)
Certification		
ANSI/AAMI EC13-1992:	Complies with all areas except those listed below: 3.1.2.1e: Heart Rate Meter Accuracy and Response to Irregular Rhythm (not tested) 3.2.6.1: Range of QRS wave amplitude and duration 3.2.7: Range and accuracy of heart rate meter (4.2.7 f: input rate of 300 bpm.) 3.2.8.1: Lower Alarm Limit (The lowest alarm limit on the 250cx Series is 35 bpm.) 3.2.9.7a: Output Display a) Channel Width 3.2.9.8c: Impulse Response 3.2.9.12: Pacemaker Pulse Display capability	
UL-60601-1:	Classified to UL-60601-1 Medical electrical equipment classified by Underwriter's Laboratories, Inc., with respect to fire, shock, and mechanical hazards in accordance with UL-60601-1.	
CUL:	Classified with respect to electric shock, fire, mechanical, and other specified hazards only, in accordance with CAN/CSA C22.2 No. 601.1	

1 Paper operating environmental conditions are for a period of less than one month. Paper storage environmental conditions are for extended storage.

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A.2 Strip Chart Recorder Specifications

Strip Chart Recorder Specifications		
Category	**Specifications**	
Heart Rate Scale	**Domestic**	**International**
Chart Width:	7 cm	8 cm
Scaling:	30 bpm/cm	20 bpm/cm
Range:	30–240 bpm	50–210 bpm
Resolution:	1 bpm	1 bpm
Uterine Activity Scale	**Tocotransducer**	
Chart Width:	4 cm	
Scaling:	25 mmHg (3.3 kPa)/cm	
Range:	0–100 mmHg (0–13.3 kPa)	
Resolution:	1 mmHg/kPa	
Maternal Pulse Oximetry MSpO2 Scale	**Domestic**	**International**
Chart Width:	4 cm	4 cm
Scaling:	12.5%/cm or 25%/cm	12.5%/cm or 25%/cm
Range:	60–100% or 0–100%	50–100% or 0–100%
Resolution:	1%	1%
Recorder Drive		
Speeds:	1, 2, and 3 cm/min	
Speed Accuracy:	± 1%	

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A.3 Operating Modes Specifications

CAUTION:
The monitor may produce incorrect results if operated outside the specified parameter specifications in below table.

Operating Modes Specifications	
Category	**Specifications**
FECG Mode	
Technique:	Peak detecting, beat-to-beat cardiotachometer
Heart Rate Counting Range:	30–240 bpm
Heart Rate Resolution:	± 1 bpm
Artifact Elimination:	Selectable, ± 25 bpm artifact rejection
Countable Input Signal Range:	15 µV to 2 mV peak-to-peak
Offset Voltage Tolerance (Differential):	± 300 mVdc maximum
Maximum Common Mode Voltage:	20 V peak-to-peak
Preamplifier Bandwidth:	1–90 Hz
Common Mode Rejection:	
Balanced:	> 120 dB at mains frequency, with patient cable
Unbalanced 5kΩ RA or LA:	> 110 dB at mains frequency
Input Equivalent Noise:	< 10 µV peak-to-peak
Input Impedance:	
Differential:	> 10 MΩ
Common Mode:	> 20 MΩ
Mains Frequency Rejection:	> 40 dB
Leakage Current:	< 10 µA at 100-240 VAC, electrically isolated
Isolation, Mains-to-Patient:	> 4 kVAC
Ultrasound Mode	
Technique:	Pulsed Doppler with autocorrelation processing
Transducer Type:	9-crystal
Pulse Repetition Frequency:	
Single Ultrasound Mode:	4 kHz
Dual Ultrasound Mode:	2 kHz
Pulse Duration:	92 µs
Transmitter Frequency:	1.151 MHz
Spatial-Peak Temporal Average Intensity:	Ispta < 10 mW/cm^2
Spatial-Average Temporal Average Intensity:	Isata< 5 mW/cm^2
Focal 20 dB Beam Area:	16.6 cm^2, at a range = 7 cm
Peak Instantaneous Intensity:	1.8 mW/cm^2
Peak-Negative Acoustic Pressure:	p < 10.0 kPa
Heart Rate Counting Range:	50–210 bpm
Leakage Current:	< 100 µA at 100-240 VAC, isolated by transducer

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Operating Modes Specifications	
Category	**Specifications**
Uterine Activity Mode	**Tocotransducer**
Range (typical):	0–100 mmHg (0–13.3 kPa)
Resolution:	1 mmHg (0.13 kPa)
Bandwidth:	dc to 0.5 Hz
Excitation Voltage:	
Zero Set Temperature Drift:	< 0.1 mmHg/°C (0.013 kPa/°C), excluding transducer
Leakage Current:	< 100 µA at 100-240 VAC, electrically isolated
MECG Mode	
Technique:	Peak detecting, beat-to-beat cardiotachometer
Maternal ECG Electrode Type:	Medtronic 1700-003 or equivalent
Leads Available:	I, II, and III
Heart Rate Counting Range:	30–240 bpm
Heart Rate Resolution:	± 1 bpm
Heart Rate Update Rate:	> 1 update per second
Countable Input Signal Range:	0.5 mV to 5 mV peak-to-peak
Baseline Drift:	< 0.5 mV RTI
Tall T-wave Rejection:	0.8 x QRS amplitude
Heart Rate Meter Response Time:	
80–120 bpm Step Increase:	< 2 seconds
80–40 bpm Step Decrease:	< 3 seconds
Alarm Time for Tachycardia 80–200 bpm:	< 10 seconds (high alarm limit at 100 bpm)
Offset Voltage Tolerance (Differential):	± 300 mVdc maximum
Maximum Common Mode Voltage:	20 V peak-to-peak
Preamplifier Bandwidth:	0.6 to 40 Hz
Common Mode Rejection:	
Balanced:	> 80 dB at mains frequency, with patient cable
Unbalanced 5K RA or LA:	> 50 dB at mains frequency
Input Equivalent Noise: Input Impedance:	< 30 µV peak-to-peak
Differential:	> 2.5 MΩ
Common Mode:	> 10 MΩ
Mains Frequency Rejection:	> 40 dB
Leakage Current:	< 10 µA at 100-240 VAC, with cable, electrically isolated
Isolation, Mains-to-Patient:	> 4 kVAC
Leads Off Detection:	dc current < 0.1 µA
Alarms:	
Audio:	Alternating 1.5-second chimes
Visual:	Flashing heart rate numeric or message
Limits:	User-selectable high and low maternal heart rate
Technical:	Leads off
Tachycardia Response Time:	< 8 seconds

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Operating Modes Specifications	
Category	**Specifications**
Pacemaker Detection/Rejection: Input Voltage Range: Input Pulse Width: Pulse Rise/Fall Time: Overshoot/Undershoot: **CAUTION:** Excessive overshoot time of pacemaker pulse may cause false QRS detection.	 ± 2.5 mV to ± 700mV 0.1 to 2 ms < 10% of pulse width; not greater than 100 µs 2 mV

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Operating Modes Specifications	
Category	**Specifications**
Maternal Blood Pressure Mode (DINAMAP® SuperSTAT)	
Technique:	Oscillometric. Microprocessor software eliminates most ambient noise and motion artifact.
Blood Pressure Range:	
Systolic	30–290 mmHg (4.0–38.7 kPa)
Diastolic Visual	10–220 mmHg (1.3–29.3 kPa)
Mean Arterial Pressure (MAP)	20–260 mmHg (2.7–34.7 kPa)
Pulse Rate Range:	30–200 bpm
Blood Pressure Accuracy:	± 5 mmHg (0.7 kPa) with a standard deviation no greater than 8 mmHg (1.1 kPa)
Pulse Rate Accuracy:	± 2 bpm or ± 2% (whichever is greater)
Cuff Inflation:	Initial inflation to 135 mmHg (18.0 kPa). Subsequent inflation approximately 30 mmHg (4.0 kPa) greater than the previous systolic pressure.
Inflation Pressure Range:	100-250 mmHg in increments of 5 (13.3 ± 33.3 kPa in steps of 0.7)
Cuff Deflation:	Automatic
Safety Features:	Automatic cuff deflation if: cuff pressure exceeds the overpressure limit of 315 mmHg ± 15 mmHg (42.0 ± 2.0 kPa); or maximum reading determination time is exceeded (not to exceed AAMI /ANSI SP10-1992 limit of 180 s); or safety timer detects microprocessor failure. Auto mode minimum 30-second delay from the end of one determination to the beginning of another to allow for venous return
Display/Record:	Systolic, diastolic, and mean pressure; pulse rate
Alarms:	
Audio	Alternating 1.5-second chimes
Visual	Flashing pressure numeric or message
Limits	User-selectable high and low systolic, diastolic, and mean pressures; User-selectable high and low pulse rate
Technical	Cuff errors, connection errors, insufficient signal, excessive inflation or determination times, overpressure, hose errors, excessive motion, communication problem, or self-test failure.
Compliance	The 250cx Series blood pressure parameter complies with the American National Standard for Electronic or Automated Sphygmomanometers [AAMI/ANSI SP10-1992]. The GE monitor values are based on the oscillometric method of noninvasive blood pressure measurement and correspond to comparisons with intra-aortic values within ANSI/AAMI Standards for accuracy.

This device is covered under one or more of the following US Patents: 6,423,010; 6,358,213; 5,704,362; 5,680,870; 5,579,776; 5,518,000; 5,170,795; 5,052,397; 4,754,761; 4,638,810 and international equivalents. USA patents pending.

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Operating Modes Specifications	
Category	**Specifications**
Maternal Pulse Oximetry Mode (Masimo)	
Technique:	Spectrophotometry and plethysmography.
Sensor Accuracy[1]:	
Sensor Model	LNOP® DC-I, LNOP-Adt, LNCS PC-I, and LNCS-Adt
Weight Range	> 30 kg
Saturation No Motion	± 2%
Accuracy Motion	± 3%
Pulse Rate No Motion	± 3 bpm
Accuracy Motion	± 5 bpm
Low Perfusion Saturation	± 2%
Accuracy Pulse Rate	± 3 bpm
Measurement Range:	
Saturation Range (SpO_2%)	1%-100%
Pulse Rate (bpm)	25-240 beats/min
Perfusion	0.02%-20%
Accuracy and Motion Tolerance:	
Saturation (SpO_2%)	
During no motion conditions - Adults[2]	70%-100% ± 2 digits
During motion conditions - Adults[3]	70%-100% ± 3 digits
Low Perfusion	70%-100% ± 2 digits
	0%-69% unspecified
Wavelengths:	
Red	663 nm, nominal
Infrared	880 nm, nominal
Maximum Optical Output Power:	
Radiant Power at 50 mA pulsed	0.13 mW, minimum
	0.79 mW, maximum
Pulse Rate (bpm)	
During no motion conditions - Adults	25 to 240 bpm ± 3 digits
During motion conditions - Adults	25 to 240 bpm ± 5 digits
Resolution:	
Saturation (SpO_2%)	1%
Pulse Rate (bpm)	1
Low Perfusion Performance[4]:	
>0.02% Pulse Amplitude and % Transmission > 5%	Saturation (SpO_2%) ± 2 digits Pulse Rate ± 3 digits
Alarms:	
Visual	Flashing SpO_2 numerics or message
Audio	Alternating 1.5-second chimes

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Operating Modes Specifications	
Category	**Specifications**
Interfering Substances	Carboxyhemoglobin may erroneously increase readings. The level of increase is approximately equal to the amount of carboxyhemoglobin present. Dyes, or any substance containing dyes, that change usual arterial pigmentation may cause erroneous readings

1) Accuracy specified when used with Masimo SET pulse oximetry modules using PC or LNC series patient cables. Numbers represent ± 1 standard deviation. Plus or minus one standard deviation represents 68% of the population.SpO_2 accuracy from 70% to 100%.Pulse Rate accuracy from 25 to 240 bpm.

2) The Masimo SET® SpO_2 parameter with LNOP-Adt sensors has been validated for no motion accuracy in human blood studies on healthy adult volunteers in induced hypoxia studies in the range of 70-100% SpO_2 against a laboratory co-oximeter and ECG monitor. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

3) The Masimo SET SpO_2 parameter with LNOP-Adt sensors has been validated for motion accuracy in human blood studies on healthy adult volunteers in induced hypoxia studies while performing rubbing and tapping motions at 2 to 4 Hz at an amplitude of 1 to 2 cm and a non-repetitive motion before 1 to 5 Hz at an amplitude of 2 to 3 cm in induced hypoxia studies in the range of 70-100% SpO_2 against a laboratory co-oximeter and ECG monitor. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population. Masimo SET technology with LNOP and LNCS sensors have been validated with human blood studies on healthy adult volunteers with induced hypoxia studies. The volunteer population composed of both men and women spanned a range of skinpigmentations from light to dark and ranged in age from 22 to 40 years old.

4) The Masimo SET SpO_2 parameter has been validated for low perfusion accuracy in bench top testing against a Biotek Index 2 simulator and Masimo's simulator with signal strengths of greater than 0.02% and a % transmission of greater than 5% for saturations ranging from 70 to 100%. This variation equals plus or minus, one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

NOTE: Because pulse oximeter equipment measurements are statistically distributed, only about two-thirds of pulse oximeter equipment measurements can be expected to fall within ± Arms of the value measured by a CO-Oximeter.

NOTE: Use of a functional SpO_2 simulator to assess the accuracy of the Corometrics™ 250cx SpO_2 parameter has not been demonstrated.

This device is covered under one or more of the following US Patents: 5,482,036;5,490,505;5,632,272;5,685,299; 5,758,644; 5,769,785; 6,002,952; 6,036,642; 6,067,462; 6,206,830; 6,157,850 and international equivalents. USA and international patents pending.

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Operating Modes Specifications (Continued)	
Category	**Specifications**
Maternal Pulse Oximetry Mode (Nellcor)	
Technique:	Spectrophotometry and plethysmography.
Sensor Type and Accuracy[1]:	SpO_2 Range:
OxiMax® Sensor Models	70%–100%:
MAX-A[2],	± 2 digits
DS-100A	± 3 digits
Saturation Range:	1–100%
Pulse Rate Range:	30–250 bpm
Accuracy:	
Saturation (SpO_2%)	
Adults[2]	
Low Perfusion[3]	70%-100% ± 2 digits
	70%-100% ± 2 digits
	0%-69% unspecified
Pulse Rate (bpm)	
Adults	20 to 250 bpm ± 3 digits
Wavelengths[4]:	
Red	660 nm, nominal
Infrared	890 nm, nominal
Maximum Optical Output Power:	< 15 mW
Response Time:	Fast
Alarms (audible and visual):	Alternating 1.5-second chimes
Audio	Flashing SpO_2 numeric or message
Visual	User-selectable high and low SpO_2; User-selectable high and low pulse rate
Limits	
Technical	Sensor errors, connection errors, insufficient signal, communication problem, internal calibration error, or self-test failure.

1) Accuracy specifications are based on controlled hypoxia studies with healthy, non-smoking adult volunteers over the specified saturation SpO_2 range. Pulse oximeter SpO_2 readings were compared to SaO_2 values of drawn blood samples measured by hemoximetry. All accuracies are expressed as ± "X" digits. This variation equals ± one standard deviation (± 1 SD), which encompasses 68%of the population. Oxygen saturation accuracy can be affected by certain environmental and patient physiological conditions, as discussed in the operator's manual for the monitor. Use Nellcor sensors only with 250cx Series Monitors containing Nellcor oximetry. Consult individual manufacturers for accuracy specifications and compatibility information of particular instruments and Nellcor sensor models. The volunteer population was composed of healthy men and women recruited from the local population. The ages ranged from 18 to 50 years old, with variations of skin pigmentations.

2) Adult specifications are shown for OxiMax®MAX-A and MAX-N sensors with the N-600. Saturation accuracy will vary by sensor type.

3) Applicability: OxiMax® MAX-A, MAX-AL, MAX-P, MAX-I, and MAX-N sensors.

4) Information of wavelength range can be especially useful to clinicians performing photodynamic therapy.

NOTE: Because pulse oximeter equipment measurements are statistically distributed, only about two-thirds of pulse oximeter equipment measurements can be expected to fall within ± Arms of the value measured by a CO-Oximeter.

NOTE: Use of a functional SpO_2 simulator to assess the accuracy of the Corometrics™ 250cx SpO_2 parameter has not been demonstrated.

This device is covered under one or more of the following Patents: US Patent No. 4,802,486; 4,869,254; 4,928,692; 4,934,372; 4,960,126; 5,078,136; 5,485,847; 5,743,263; 5,865,736; 6,035,223; 6,298,252; 6,463,310; 6,591,123; 6,675,031; 6,708,049; 6,801,797; Re. 35,122; and foreign equivalents.

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Appendix B: Alarm Summary

Type	Condition	Visible Advisory	Audible Advisory
FHR	An alarm setting (audio or high/low limit) is turned off. Alarm Defaults Audio: on Volume: 5 Limits: High = 160 bpm, Low = 120 bpm	displays to the left of the FHR mode title.	
	FHR limit (high or low) actively being violated. or Unsilenced, resolved FHR limit violation (the limit was violated but the FHR has since returned to the normal range before clinical acknowledgement). For continuous limit violations: a high alarm activates after 5 minutes; a low alarm activates after 30 seconds. **About Latching Alarms**: The FHR limit alarms are latching alarms which means that a clinician must acknowledge the alarm using the monitor's **Alarm Silence** button in order to clear the alarm.	FHR numeric flashes.	Alternating high/low tones (if audio enabled).
	Inadequate FHR signal quality.	Flashing dashes "– – –" in place of FHR numeric.	Alternating high/low tones (if audio enabled).
NIBP	Systolic, diastolic, or MAP pressure value (high or low) actively being violated.	NIBP numeric (systolic, diastolic, or MAP) flashes.	Alternating high/low tones (if audio enabled).
	Malfunction with NIBP circuitry, cuff, or air hoses.	*CHECK CUFF, LEAK, COMM, MOTION, WEAK SIGNAL*, or *REPAIR* message displays in *NIBP* area.	Alternating high/low tones (if audio enabled).

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Type	Condition	Visible Advisory	Audible Advisory
MHR/P[1]	Alarm Defaults Audio: on Volume: 5 Limits: High = 120 bpm, Low = 50 bpm Re-alarm: 120 sec		—
	MHR/P limit (high or low) actively being violated.	MHR/P numeric flashes.	
	The tachycardia response time is < 8 seconds.		Alternating high/low tones (if audio enabled).
	Asystole.	Flashing dashes "– – –" in place of MHR/P numeric.	Alternating high/low tones (if audio enabled).
	MECG leads off.	Flashing dashes "– – –" in place of MHR/P numeric and MECG LEADS OFF message displays underneath.	Alternating high/low tones (if audio enabled).
[1] There is an MECG re-alarm.			
$MSpO_2$	Alarm Defaults Audio: on Volume: 5 Limits: High = 100%, Low = 95% Re-alarm: 120 sec		—
	$MSpO_2$ limit (high or low) actively being violated. Issued after about 8 seconds.	$MSpO_2$ numeric flashes. $MSpO_2$ value and pulse rate print on the strip chart.	Alternating high/low tones (if audio enabled).
	Malfunction with $MSpO_2$ circuitry.	*COMM* or *REPAIR* message displays in $MSpO_2$ area.	Alternating high/low tones (if audio enabled).
	$MSpO_2$ intermediate cable disconnected from monitor; sensor assembly disconnected from intermediate cable; or sensor or cable has a broken wire.	Dashes "– – –" in place of $MSpO^2$ numeric.	Alternating high/low tones (if audio enabled).

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Appendix C: Electromagnetic Compatibility

Changes or modifications to this system not expressly approved by GE Healthcare can cause EMC issues with this or other equipment. This system is designed and tested to comply with applicable regulation regarding EMC and must be installed and put into service according to the EMC information stated in this appendix.

WARNING:
Use of portable phones or other radio frequency (RF) emitting equipment near the system may cause unexpected or adverse operation. The equipment or system should not be used adjacent to, or stacked with, other equipment. If adjacent or stacked use is necessary, the equipment or system should be tested to verify normal operation in the configuration in which it is being used.

C.1 Manufacturer's Guidance and Declaration – Electromagnetic Emissions

The Corometrics™ 250cx Series Maternal/Fetal Monitor is intended for use in the electromagnetic environment specified below. It is the responsibility of the customer or user to ensure that the monitor unit is used in such an environment.

Emissions Test	Compliance	Electromagnetic Environment - Guidance
RF Emissions EN 55011	Group 1	The equipment uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF Emissions EN 55011	Class A	The equipment is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic Emissions EN 61000-3-2	Class A	
Voltage Fluctuations/ Flicker Emissions EN 61000-3-3	Complies	

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C.2 Manufacturer's Guidance and Declaration – Electromagnetic Immunity

The Corometrics™ 250cx Series Maternal/Fetal Monitor is intended for use in the electromagnetic environment specified below. It is the responsibility of the customer or user to enssure that the monitor unit is used in such an environment.

Immunity Test	EN60601 Test Leve	Compliance Level	Electromagnetic Environment – Guidance
Electromagnetic Discharge (ESD) EN 61000-4-2	± 6 kV contact ± 8 kV air	± 6 kV contact ± 8 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative air humidity should be at least 30%.
Electrical Fast Transient/Burst EN 61000-4-4	± 2 kV for power supply lines ±1 kV for input/output lines	± 2 kV for power supply lines ±1 kV for input/output lines	Mains power should be that of a typical commercial or hospital environment.
Surge EN 61000-4-5	± 1 kV differential mode ± 2 kV common mode	± 1 kV differential mode ± 2 kV common mode	Mains power should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines EN 61000-4-11	<5% U_t (>95% dip in Ut) for 0.5 cycles <40% U_t (>60% dip in U_t)for 5 cycles <70% U_t (>30% dip in U_t)for 25 cycles <5% U_t (>95% dip in U_t)for 5 s	<5% U_t (>95% dip in U_t) for 0.5 cycles <40% U_t (>60% dip in U_t) for 5 cycles <70% U_t (>30% dip in U_t) for 25 cycles <5% U_t (>95% dip in U_t) for 5 s	Mains power should be that of a typical commercial or hospital environment. If the user of the equipment requires continued operation during power mains interruptions, it is recommended that the equipment be powered from an uninterruptible power supply or a battery.
Power Frequency (50/60 Hz) Magnetic Field EN 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristics of a typical location in a typical commercial or hospital environment.

NOTE: U_t is the AC mains voltage prior to application of the test level.

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Immunity Test	EN6061 Test Level	Compliance Level	Electromagnetic Environment - Guidance
Conducted RF EN 61000-4-6	3 Vrms 150 KHz to 80 MHz	3 Vrms	Portable and mobile RF communications equipment should not be used closer to any part of the equipment, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended separation distance** d = 1.2 √P d = 1.2 √P 80 MHz to 800 MHz d = 2.3 √P 800 MHz to 2.5 GHz where ***P*** is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer, and *d* is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey[a], should be less than the compliance level in each frequency range[b]. Interference may occur in the vicinity of equipment marked with the following symbol:
Radiated RF EN 61000-4-3	3 V/m 80 MHz to 2.5 GHz	3 V/m	

NOTE: At 80 MHz and 800 MHz, the higher frequency range applies.

NOTE: These guidelines may not apply in all situations. Electromagnetic propagation is affected by reflection from structures, objects, and people.

[a] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radio, AM and FM radio broadcast, and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the equipment is used exceeds the applicable RF compliance level above, the equipment should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the equipment.

[b] Over the frequency range 150 KHz to 80 MHz, field strengths should be less than 3 V/m.

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C.3 Recommended Separation Distances

The table below provides the recommended separation distances (in meters) between portable and mobile RF communications equipment and the Corometrics™ 250cx Series Maternal/Fetal Monitor.

The monitor unit is intended for use in the electromagnetic environment on which radiated RF disturbances are controlled. The customer or the user of the monitor unit can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the monitor unit as recommended below, according to the maximum output power of the communications equipment.

	Separation Distance in Meters (m) According to Frequency of Transmitter		
Rated Maximum Output Power of Transmitter (W)	**150 kHz to 80 MHz [a] $d = 1.2\sqrt{P}$**	**80 MHz to 800 MHz [a] $d = 1.2\sqrt{P}$**	**800 MHz to 2.5 GHz [a] $d = 2.3\sqrt{P}$**
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

[a]At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

For transmitters rated at a maximum output power not listed above, the recommended separation distance [*d*] in meters (m) can be estimated using the equitation applicable to the frequency of the transmitter, where *P* is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

NOTE: These guidelines may not apply in all instances. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

C.4 Compliant Cables and Accessories

WARNING:
The use of accessories, transducers and cables other than those specified may result in increased emissions or decreased immunity performance of the equipment or system.

The table below lists cables, transducers, and other applicable accessories with which GE Healthcare claims EMC compliance.

NOTE: The supplied accessories that do not affect EMC compliance are not included.

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Part No	Description	Maximum Lengths
ECG Cables		
1442AAO	Y Adapter Cable Maternal/Fetal ECG, Rectangular	.46 m /18 in
1442BAO	FECG Socket Adapter	.46 m /18 in
1553AAO	Multi-Link Cable, 3 Lead ECG Maternal, AHA, Rectangle	3.6 m / 12 ft
1553BAO	Multi-Link Cable, 3 Lead ECG Maternal, IEC, Rectangle	3.6 m /12 ft
1564AAO	120 Recorder Cable MECG	3.6 m /12 ft
1590AAO	Qwik Connect Plus cable (Round)	2.4 m / 8 ft
1591AAO	Qwik Connect Plus FSE Cable (Leg Plate Cable), Rectangle	2.4 m / 8 ft
412682-001	Leadwire set, AHA Grabber	N/A
412682-003	Leadwire set, IEC Grabber	N/A
7000AAO	Fetal Spiral Electrodes, Qwik Connect Plus	N/A
Intrauterine Pressure Catheters		
2076CAO	COROMETRICS ACCU TRACE IUPC, 10/CARTON	N/A
1336DAO	IUPC Cable ACCUTRACE, COROMETRICS	3.6 m / 12 ft
SpO2 / Pulse Oximetry Cables and Sensors		
407705-006	Nellcor DuraSensor® Reusable Finger Probe	N/A
2016041-001	Masimo SpO_2 patient adapter cable	3.6 m / 12 ft
2017002-003	MASIMO $MSpO_2$ INTERMED CABLE, 120 SERIES	N/A
2002800-001	MASIMO reusable finger sensor	N/A
2023597-001	MASIMO SET adult reusable finger sensor	N/A
2025350-001	Nellcor $MSpO_2$ INTERMED CABLE, 120 SERIESN/	N/A
170053	Nellcor OXYGEN XDCRS	N/A
TOCO Cables		
2264HAX	Nautilus Tocotransducer Cable, Loop Style	2.4 m / 8 ft
2264LAX	Nautilus Tocotransducer Cable, Button Style	3 m / 10 ft
Ultrasound Cables		
5700HAX	Nautilus Ultrasound Transducer Cable, Loop Style	2.4 m / 8 ft
5700LAX	Nautilus Ultrasound Transducer Cable, Button Style	3 m / 10 ft
Accessories		
0146AAY	Fetal Acoustic Stimulator (FAST)	2.4 m / 8 ft
1426CAO	Interface cable, HP OBMS / ODIS	1.83m / 6 ft
1426DAO	Interface cable, HP OBMS / ODIS	3.6 m / 12 ft
1558AAO	120 to QS Comm Cable	3 m / 10 ft
1558AAO	120 to QS Comm Cable	3 m / 10 ft
1558BAO	120 to QS Comm Cable	6 m / 20 ft
1562AAO	120/Critikon Interface cable	0.3 m / 1 ft
1562BAO	120/Critikon Interface cable	1.83m / 6 ft
1563AAO	120/340 Interface cable	3 m / 10 ft

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Part No	Description	Maximum Lengths
1567AAO	120/Traceview Cable, HP Mon to Traceview 120	3 m / 10 ft
1568AAO	120/Traceview Adapter Cable	.36m / 1 ft
1569AAO	120/Peritronics Cable, Cent Surv Intfc Cbl 120	3 m / 10 ft
1580AAO	Cable Assy, 120 to WATCHCHILD	3 m / 10 ft
2007234-001	Cable, Coro – DINAMAP PRO Series	3 m / 10 ft
2116BAX	2116B Data Entry System	N/A
3919BAO	Remote Event Marker	2.4 m / 8 ft
600028	AC cord, Hospital grade, AHA	2.4 m / 8 ft
600034	AC Cord, Hospital Grade, IEC	2.4 m / 8 ft
600049	AC Cord, Hospital Grade, UK	2.4 m / 8 ft
401855-110	AC Cord, Hospital Grade, Australia / New Zealand	2.5m / 8.2ft
919 200 37	Potential Equalization cable	3 m / 10 ft

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Appendix D: PS320 Fetal Simulator Setup

The Fluke® PS320 fetal simulator provides fetal ECG, maternal ECG, ultrasound, and uterine activity simulation signals for testing and troubleshooting of fetal monitors. PS320 fetal simulator operates on a 9V battery and simulates several fetal parameters, including twins. An optional mechanical heart creates fetal heart sounds for testing fetal monitor ultrasound cables and transducers.

D.1 Parts Required

Below parts are required to perform all the necessary tests on Corometrics™ 250cx Series monitors using a PS320 fetal simulator:

1. Parts to be ordered from Fluke® Biomedical:
   - One PS320 Fetal Monitoring Kit for GE Corometrics (Fluke part number: 2794057): This kit includes the following items:
     - One PS320 fetal simulator unit
     - One MFH-1 Mechanical Heart Probe and Fetal Heart Cable
     - One Ultrasound Simulation Cable for Corometrics
     - One External TOCO Simulation Cable for Corometrics
     - One IUP TOCO Simulation Cable for Corometrics
     - One RS-232 Cable
     - Operator Manual, Battery, and Battery Eliminator

NOTE: The above information is extracted from Fluke® Biomedical website and might change without an advanced notice. Always visit Fluke® Biomedical website (www.flukebiomedical.com) before ordering parts to get the latest ordering information.

2. Parts to be ordered from GE Healthcare:
   - One Coro250cx ECG Cables FRU Kit (GE Part number: 2025177-055): This kit includes one FECG simulation cable and one MECG simulation cable.

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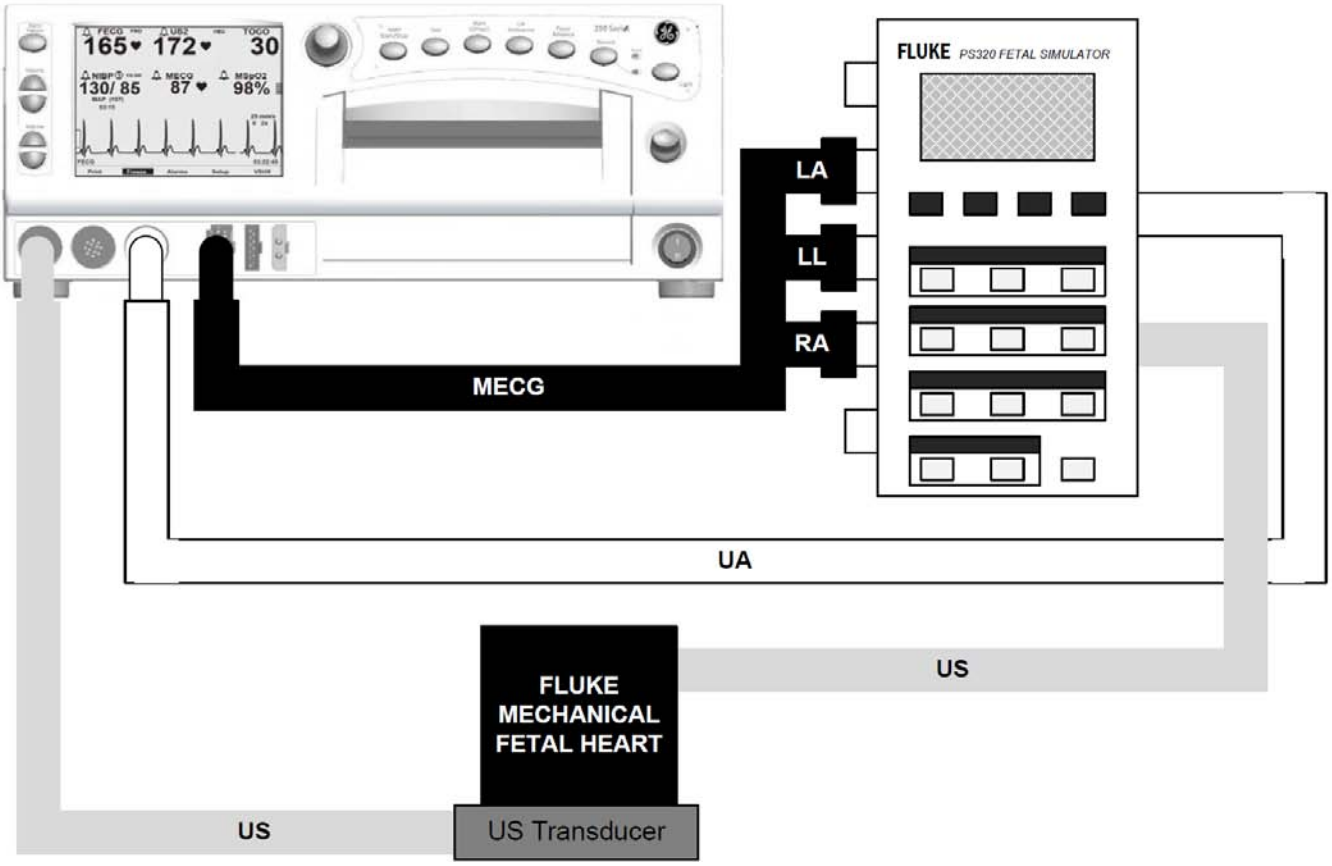
D.2 PS320 Fetal Simulator Setup

This section provides instructions to perform the PS320 fetal simulator setup.

NOTE: The PS320 fetal simulator needs periodic calibration. Always use a calibrated PS320 unit for performing tests.

1. Connect the ECG/US/TOCO simulation cables to their corresponding connectors on PS320 fetal simulator and Corometrics™ 250cx Series monitor unit as illustrated in Figure D-1.



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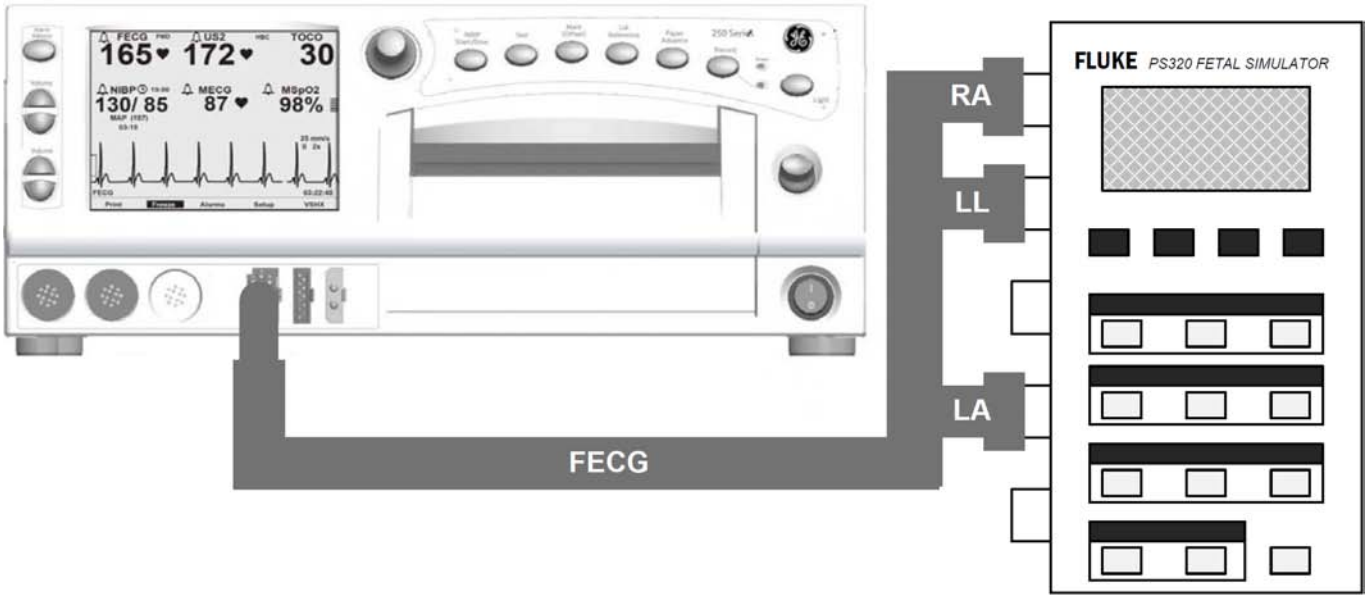

Figure D-1 PS320 Setup

NOTE: For FECG connection, use Fetal, Fet/Mat, and Reference connectors on the PS320 simulator. For MECG connection, use Fet/Mat, Maternal, and Reference connectors on the PS320 simulator.

2. Turn on the monitor unit and the PS320 fetal simulator.

3. The PS320 default settings (see below) are active. Use PS320 front panel keys to change the fetal ECG rate/amplitude, maternal ECG rate/amplitude, TOCO level and sensitivity if necessary. Press the Enter key to confirm selections.

   PS320 default settings:

   US1 = 150 BPM (static), US2 = NORMAL, FETAL ECG = 150 BPM (Sensitivity 1 μV), MAT. ECG = 80 BPM (Sensitivity 1 μV), TOCO = 00 (Sensitivity 5 μV)

4. For additional settings, use the Main, Sub, and Scrolls keys of PS320 front panel to access the different parameters to set. Press Enter to confirm the selection and make the change.

5. Use the View key at any time to see the currently-active settings on the PS320 unit.

NOTE: For detailed information about operating the PS320 fetal simulator, refer to the PS320 user's manual available to download at Fluke® Biomedical website (www.flukebiomedical.com).

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Appendix E: Service Mode Screens

The Corometrics™ 250cx Series monitor provides a variety of options that are selected in the setup screens on the display using the Trim Knob Control. Depending on the intended user, the setup screens can generally be categorized into two groups:

a. Operator setup screens: These screens are available and intended for the operator's use. The operator can access the following setup screens: *FECG, US, US2, Maternal NIBP, MSpO$_2$, MHR/P, Master Alarm*, *VSHX*, and *General Setup*. For detailed information on setup screens, refer to Corometrics™ 250cx Series Monitor Operator Manual.

b. Service mode screens: These screens are password-protected and intended for the use of authorized service personnel only. The monitor has five service mode screens: *Service Lock, Install Options Screen 1 and 2, Communications Setup, Error Log, Diagnostic Control*, *J102*, and *NIBP Calibration*

This appendix covers the information about the service mode screens and the description of fields in each screen.

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E.1 Service Lock Screen

The *Service Lock* screen (See Figure E-1) is the first screen when entering the monitor service mode.

Figure E-1 Service Lock Screen

To access this screen:

1. Select the *Setup* softkey in the *General* screen to display the *General Setup* screen.

2. Select the *Service* softkey from the *General Setup* screen.

3. The *Service Lock* screen appears and the access code is displayed as *0 0 0 0*.

The *Service Lock* screen requires the user to enter a password to prevent unauthorized access to the service mode. The access code is the current month and day (MMDD) or day and month (DDMM), depending on how the monitor is configured. Use the Trim Knob Control to enter the access code. For example: April 23 shall be entered *0 4 2 3*. The screen also displays the following information:

- Keypad Version
- $MSpO_2$ information:
  - For Nellcor: Nellcor 506 or NELL-3 Version and Date
  - For Masimo: DSP: Version, MCU: Version, PID: Version
- NIBP Version
- CPU Version
- DSP Version

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E.2 Install Options Screens

Upon entering the correct access code in *Service Lock* screen and pressing the Trim Knob Control, the monitor displays *Install Options Screen 1* (See Figure E-2). This screen includes the following option fields to configure:

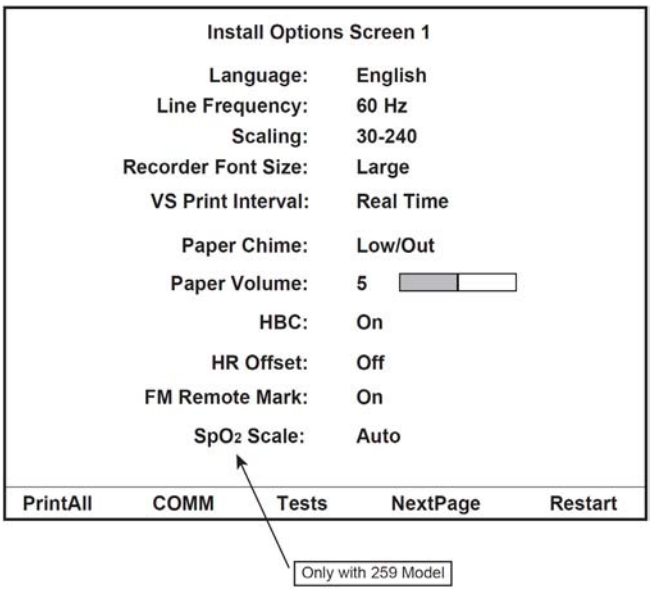

Figure E-2 Install Options Screen 1

- **Language:** This field is used to set the language shown on the display and printed on the strip chart recorder paper. Use the Trim Knob Control to cycle through the available options: *English*, *Spanish*, *French*, *German*, *Dutch*, *Swedish*, *Italian*, *Danish*, *Finnish*, and *Norwegian*.

  NOTE: The correct country language is set at the factory prior to shipment of the product to the target country.

- **Line Frequency:** This field is used to set the line power frequency for the country in which the monitor is being used. Use the Trim Knob control to alternate between *50 Hz* and *60 Hz*.

  NOTE: The correct country line power frequency is set at the factory prior to shipment of the product to the target country.

- **Scaling:** This field is used to set the heart rate scale for the strip chart paper. Use the Trim Knob Control to alternate between *30–240 bpm/cm* and *50–210 bpm/cm*. The $MSpO_2$ trend *Auto scale* is also affected by this setting. When the heart rate scale is 30–240, the $MSpO_2$ expanded scale is 60–100% (10%/cm). When the heart rate scale is 50–210, the $MSpO_2$ expanded scale is 50–100% (12.5%/cm).

  NOTE: The correct country scaling is set at the factory prior to shipment of the product to the target country.

- **Recorder Font Size**: This field offers three font size options for print annotations:
  - *Small*: This option results in print speed increase.
  - *Medium*: This option is a compromise between the large and small sizes.
  - *Large*: This option fosters readability.

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- **VS Print Interval:** This field provides two options for the printing of blood pressure and $MSpO_2$ values on the strip chart paper:
    - *Real-Time:* Values are printed according to the actual clock time (9:33, 9:48, 10:03, etc.).
    - *Chart-Style*: Values are printed on standard clock quarter (9:00, 9:15, 9:30, 9:45, etc.), half hour (9:00, 9:30, 10:00, 10:30, etc.), and whole hour (9:00, 10:00, 11:00, 12:00, etc.) marks.
- **Paper Chime**: This field enables/disables an audible tone to indicate a low-paper or out-of-paper condition.
    - *Off*: No audio tone is generated during a low-paper or out-of-paper condition (the Recorder LED blinking will still be present).
    - *Low/Out*: An audio tone is generated during a low-battery or out-of-paper condition.
    - *Out Only*: An audio tone is generated only during an out-of-paper condition.
- **Paper Volume:** This field sets the volume of the paper chime. As the volume is adjusted, a sample tone is generated. You can choose from a range of 1 to 9 (*1* = lowest, *9* = loudest).
- **HBC (Heartbeat Coincidence):** This field is used to enable/disable the heartbeat coincidence feature. The feature alerts the user when monitoring a duplicate signal is likely. Heartbeat coincidence is indicated when any two heartbeats have a consistent phase relationship for equal to or greater than 60% of the detected beats for about 60 seconds. The cessation of coincidence is indicated when the phase relationship is inconsistent for greater than 40% of the detected beats for about 7 seconds. When heartbeat coincidence detection is enabled, the acronym HBC appears to the right side of the FHR2 mode title.
- **HR Offset:** This field is used to enable/disable the secondary offset feature. When monitoring dual heart rates using US/US2 or FECG/US, overlapping traces may be difficult to interpret. All Corometrics™ 250cx Series monitors provide a +20 bpm shift for the secondary fetal heart rate trend to alleviate this problem. When using US/US2 or FECG/US2, and the US2 trace is shifted +20 bpm, the US2+20 symbol prints on the upper portion of the top grid every 4.5 cm. When using US/FECG, and the US trace is shifted +20 bpm, the US + 20 symbol prints on the upper portion of the top grid every 4.5 cm. In both cases, an arrow (→) and a vertical dashed line are printed to draw attention to the start of the shifted trend.

  Use the Trim Knob Control to cycle through below available options:

    - *10 min*: The heart rate offset mode is enabled with an auto-revert feature. If the trace is shifted by the user, the heart rate will revert back to the normal (unshifted) level after 10 minutes. This option is the factory default setting.
    - *On*: The heart rate offset mode is enabled. If the user shifts a trace, the trace will remain shifted until the user manually sets the trace back to normal (unshifted level).
    - *Off*: The heart rate offset mode is disabled. The user cannot shift traces.
- **FM Remote Mark:** This field configures the marker annotation that is printed on the strip chart paper whenever a patient presses the button on the Remote Marker accessory. Use the Trim Knob Control to alternate between *On* and *Off*. The factory default setting is *Off*. The (↑) annotation is commonly used to record an event while the (F↑M) annotation is commonly used as an indication that the mother has perceived fetal movement.

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- **SpO_2 Scale:** This field is only available on Corometrics™ 259cx model. Two below scale options can be selected for printing the $MSpO_2$ trends. The scale is printed on the paper along with the trend.
    - *Auto*: The trend plots on an expanded scale of 60–100% or 50–100%, depending on the paper*.
    - *0–100%:* This option configures the $MSpO_2$ trend to always plot at a fixed scale of 0–100%.

    * The $MSp0_2$ trend is plotted over a range of 60-100% on paper with a HR scale of 30-240 bpm. The $MSp0_2$ trend is plotted over a range of 50-100% on paper with a HR scale of 50-210 bpm.

Use the Trim Knob Control to select *NextPage* softkey on the bottom of *Install Options Screen 1* screen to access *Install Options Screen 2* screen (See Figure E-3). This screen includes the following option fields to configure:

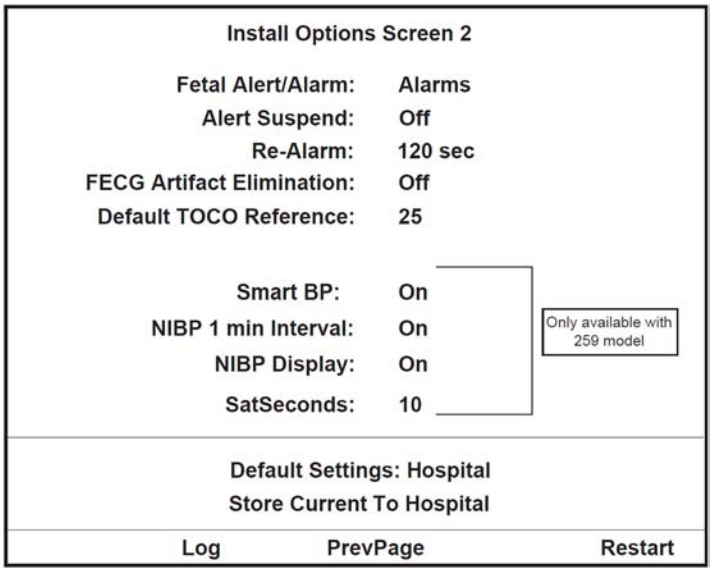

Figure E-3 Install Options Screen 2

- **Fetal Alert/Alarms:** If the Spectra Alerts option is installed on the monitor, use this field to select between the built-in FHR alarm features of the monitor and the Spectra Alerts option.
    - *Alarms:* The monitor generates alarms based on the limit settings provided on the FHR setup screens.
    - *Alerts:* Enables the Spectra Alerts feature to analyze heart rate and uterine activity data to detect certain abnormal trends and alert the clinician.
- **Alert Suspend:** This field let the user to suspend the audio component of alerts.
    - *Off* (disabled): This option will disable the user to suspend audio alerts.
    - *On* (enabled)*:* This option will enable the user to manually activate/de-activate the function.
- **Re-Alarm:** This field adjusts the temporary silence period. An audio alarm is cancelled using the Alarm Silence button. However, for MECG and $MSpO_2$ monitoring and during a paper-load error condition, an alarm will be re-issued if the alarm state continues after a specified amount of time.
- **FECG Artifact Elimination:** This field is used to enable/disable FECG Artifact Elimination feature which only affects the direct FECG mode. Use the Trim Knob Control to alternate between *On* and *Off* (The factory default setting is *Off*.). When *On* is selected, any new heart rate value which differs by more than ±25 bpm

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from the previously calculated heart rate is not printed on the strip chart paper. When *Off* is selected, all heart rate values are printed on the strip chart paper without regard to previous rates.

When FECG artifact elimination is turned on, the monitor does not print any new FHR value which differs by more than ±25 BPM from the previously calculated heart rate value. The printing inhibition functions on a beat-to-beat basis by comparing the last calculated rate against the newly calculated rate. The rate used for comparison purposes is always the previous rate regardless of whether this rate passed the previous ±25 BPM test. When FECG artifact elimination is turned off, the direct FECG rate is plotted by the recorder without regard to its deviation from the previous rate. The effect of this function change is that sudden heart rate changes (such as certain arrhythmias, accelerations or decelerations) as well as artifactual changes (as when the electrode is disturbed or loosely connected) are recorded when FECG artifact elimination is turned off. They are not recorded when FECG artifact elimination is turned on; instead gaps (pen lift) in the tracing occur.

- **Default TOCO Reference**: This field sets the default uterine activity pressure reference for the TOCO transducer. Use the Trim Knob Control to cycle through the available settings: *5, 10, 15, 20,* or *25* relative units in mmHg mode or *0.7, 1.3, 2.0, 2.7*, or *3.3* in kPa mode. (The factory default setting is 10 in mmHg mode or 1.3 in kPa mode.)

  When using a TOCO transducer, momentary depression of the UA Reference button sets the pressure baseline at the default setting. Pressing the UA Reference button for more than 2 seconds causes the UA reference value to override the default setting and cycle through all available selections: *5, 10, 15, 20*, or *25* relative units in mmHg mode or *0.7, 1.3, 2.0, 2.7*, or *3.3* in kPa mode, starting at the default setting until the button is released. This value is stored as the new baseline for the currently measured uterine activity signal; as soon as the UA Reference button is momentarily pressed, the baseline returns to the default value.

- **Smart BP:** This field is only available on Corometrics™ 259cx model. The feature prevents an automatic blood pressure determination from occurring during a uterine contraction. This feature reduces the chances for erroneous vital signs readings and also reduces patient discomfort during labor.
- **NIBP 1 min Interval:** This field is only available on Corometrics™ 259cx model. The field is used to enable/disable the 1 minute interval selection on the maternal *BP Setup* screen. Use the Trim Knob Control to alternate between *On* and *Off* (The factory default setting is *Off*.).
- **NIBP Display:** This field is only available on Corometrics™ 259cx model. The field determines the time period (in minutes) that a blood pressure reading remains displayed before being automatically erased*, starting from the time the reading is displayed. Setting this field to a value reduces the chance of error. Setting this field to *On* leaves the blood pressure reading displayed indefinitely and could potentially cause confusion. For Example: if the monitor is configured for manual mode and one hour has elapsed since the last reading, the continuous display of the “old” NIBP reading may cause confusion.

  * Values are removed from the NIBP area of the display only; values are still retained in memory for display and printing in the Maternal Vital Signs History screen.

- **Pressure Units:** This field allows the user to choose pressure units: *mmHg* or *kPa*.
- **SatSeconds:** This field is only available on Corometrics™ 259cx model. The field sets a limit to control the time that the SpO_2 level may fall outside the alarm before an audible alarm sounds (The factory default setting is 10). The limit can be set to: *Off*, *10, 25, 50, or 100*.
- **Default Settings:** The setup screens of Corometrics™ 250cx Series monitors are set to factory defaults in the factory before shipment to the customers. This field determines the settings that the monitor loads and uses on the next power-on or restart. The field provides two options:

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- *Factory*: Select this option to make all monitor settings revert back to the factory default settings (See section E.9.2) on the next power-on or restart.
- *Hospital:* Select this option to let the monitor utilizes the hospital-preferred settings (not the factory default ones) on the next power-on or restart.

NOTE: The hospital-preferred settings will take into effect only after the user stores the settings using Store Current To Hospital field before turning off or restarting the monitor unit.

- **Store Current To Hospital**: Select this option to store the current monitor settings as the hospital-preferred default settings. When you select this option, the Default Settings field will reflect the change (i.e., Default Settings field changes to *Hospital*).

E.3 Printing Setup Information

Use the Trim Knob Control to select the *PrintAll* softkey on the bottom of *Install Options Screen 1* screen to see an overall summary of the monitor setup screens. A screen capture of each system setup screen (user and service) will be printed on the strip chart paper.

Diagnostic Control, Communications Setup, Install Options, General Setup, Master Alarm Setup, Vital Signs History, $MSpO_2$ Setup, MHR/P Setup, NIBP Setup, FECG Setup, US Setup, US2 Setup

NOTE: The *FECG, US*, and *US2 Setup* screens are shown together in one group. The *HR Offset* field is separated on this summary screen, since it may appear on either the *US* or the *US2 Setup* screen—depending on the active connectors.

E.4 Communications Setup Screen

The *Communications Setup* screen (See Figure E-4) let the user configure the J109, J110, and J111 RS-232C Serial Interface ports of the monitor unit for connecting to optional peripheral equipment. Each port is configured for baud rate and mode.

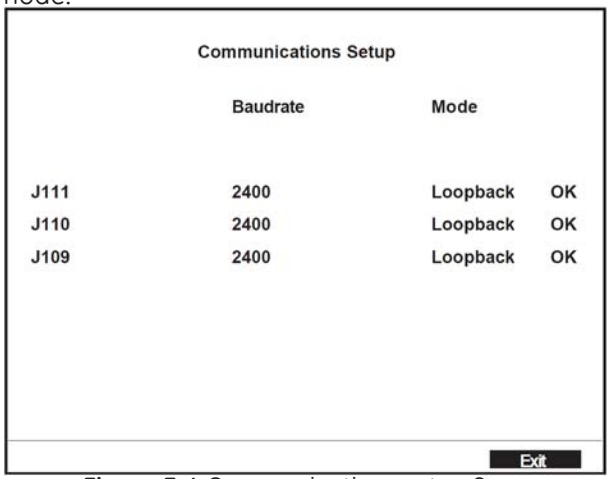

Figure E-4 Communications setup Screen

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Select the *COMM* softkey on *Install Options Screen 1* screen to access the *Communications Setup* screen and set below fields:

- *Baud rate:* This field sets the baud rate for communication with an external device. Use the Trim Knob Control to cycle through the available settings: *600*, *1200*, *2400*, *4800*, *9600*, and *19,200 bps*. Each port is factory set to *2400 bps*.
- *Mode*: This field selects the mode for communication with an external device. Use the Trim Knob Control to cycle through the available settings: *Nellcor*, *Factory*, *Critikon*, *1371*, *1371/NOTES*, *LOOPBACK*, *115*, *115 X/R*, and *Exergen TAT*. Each port is factory set to the *1371/Notes* mode.

NOTE: The monitor with the factory settings is ready for connection to a Centricity Perinatal system.

E.5 Error Log Screen

The *Error Log* screen displays a service log of the monitor unit and is useful for diagnosing intermittent problems (See Figure E-5). There are 255 error codes that can be detected by the monitor. The *Error Log* is comprised of multiple pages with up to 20 error codes per screen. Each screen displays three columns:

- The Error ID column lists the error code. The Count column lists the number times the error code has occurred.
- The Data column lists other information associated with the error code. This column is for factory use only.

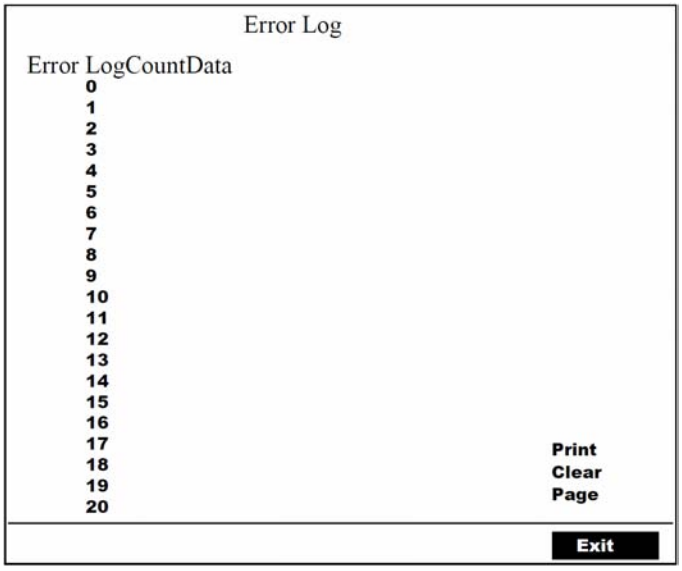

Figure E-5 Error Log Screen

To access the *Error Log* screen, follow the below instructions:

1. Select the *Log* softkey from *Install Options Screen 2*. The first *Event Log* screen displays.

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2. Use the *Page* softkey to display the next screen (page), if applicable. The last page wraps back to the first page.

3. Use the *Print* softkey to print the displayed screen (page) on the strip chart recorder.

4. Use the *Clear* softkey to clear all the error log from the battery-backed RAM.

E.6 Diagnostic Control Screen

The *Diagnostic Control* screen is used to perform some diagnostic self-tests (See Figure E-6). Select *Tests* softkey in *Install Options Screen 1* screen to access the *Diagnostic Control* screen.

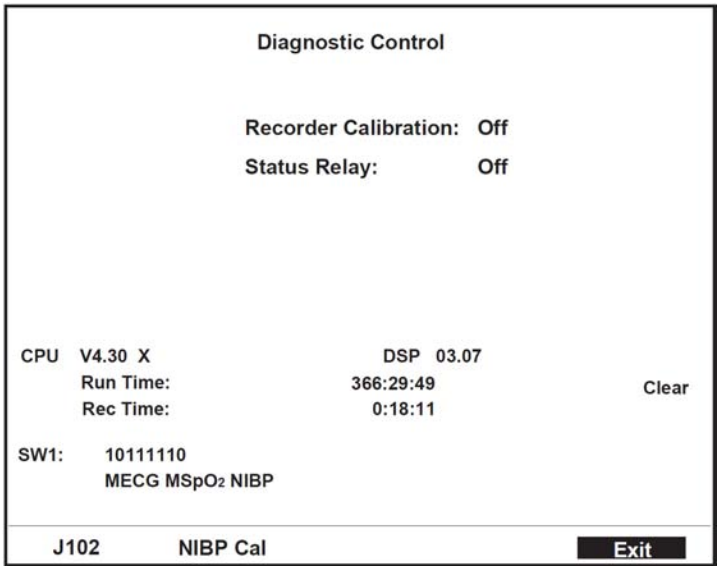

Figure E-6 Diagnostic Control Screen

This screen includes the following fields to select:

- **Recorder Calibration:** This test provides a method of testing the recorder calibration alignments. Use the Trim Knob Control to set the recorder calibration field on the *Diagnostic Control* service mode screen to *On*. The recorder prints four continuous horizontal lines at 0 mmHg, 30 bpm, and 240 bpm and the minimum and maximum rates on the HR scale (30 bpm and 240 bpm for domestic paper, 50 bpm and 210 bpm for international paper). The recorder prints a vertical line spanning across both grids every 3/16 inch. Use this test while performing recorder offset adjustments in section 5.11.1 and See 5.11.2. The test will continue to print the lines until you cycle power on the monitor or set the calibration field on the Diagnostic Control screen back to *Off*.
- **Status Relay:** This softkey tests Nurse Call Interface relay.
- **CPU:** This field displays the software version number of the main processor installed on the Main Board of the monitor unit.
- **DSP**: This field displays the software version number of the processor installed on the DSP Board of the monitor unit.

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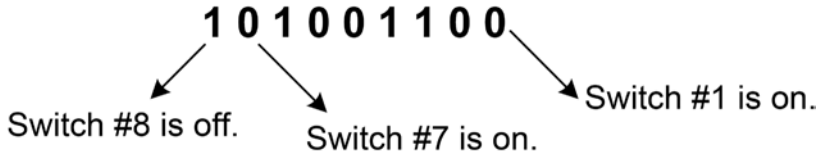
- **Run Time**: This field displays the amount of time the monitor has been turned on since the last time that this field was cleared. The time is displayed in hours, minutes, and seconds. To clear this field (reset the timer), activate the *Clear* softkey to the right of the run time field.

  NOTE: The *Clear* softkey also resets the Rec Time field.

- **Rec Time:** This field displays the amount of time the recorder has been turned on (or printing in maternal-only mode) since the last time that this field was cleared. The time is displayed in hours, minutes, and seconds. To clear this field (reset the timer), activate the *Clear* softkey to the right of the recorder time field.

  NOTE: The *Clear* softkey also resets the Run Time field.

- **Clear softkey:** This softkey sets the monitor run time and recorder record time to 0:00.
- **SW1:** This field shows the setting status of SW1 switch on the Main Board (See Table 1-2). Below is an example of the SW1 switch status:



E.7 J102 Screen

Select *J102* softkey in *Diagnostic Control* screen to access *J102* screen (See Figure E-7).

This screen displays five columns:

- Pin: refers to the physical pin number of the connector.
- Signal: refers to the signal description.
- Range: refers to the expected range of outputs under normal operating conditions.
- Voltage: refers to the actual voltage at the pin with the ground referenced to Pin 3 (ANALOG GND).
- Meaning: refers to the intended interpretation of the voltage indicated in the voltage field.

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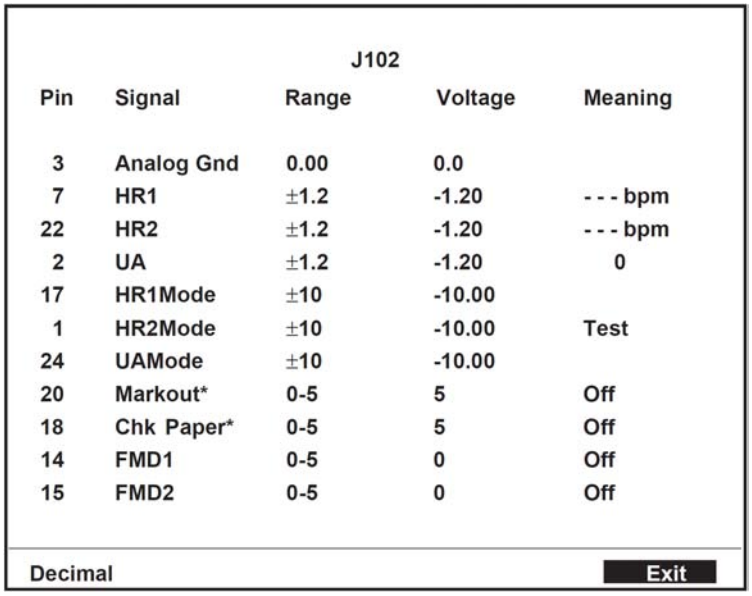
J102
Pin Signal Range Voltage Meaning
3 Analog Gnd 0.00 0.0
7 HR1 ±1.2 -1.20 - - - bpm
22 HR2 ±1.2 -1.20 - - - bpm
2 UA ±1.2 -1.20 0
17 HR1Mode ±10 -10.00
1 HR2Mode ±10 -10.00 Test
24 UAMode ±10 -10.00
20 Markout* 0-5 5 Off
18 Chk Paper* 0-5 5 Off
14 FMD1 0-5 0 Off
15 FMD2 0-5 0 Off
Decimal
Exit

Figure E-7 J102 Test Screen

The Range and Voltage fields can be displayed using a decimal point or a comma as a separator. Each activation of the Decimal softkey at the bottom of the screen alternates between using a decimal and a comma. To test J012 pin outputs, rotate the Trim Knob Control to the desired row (Pin). The cursor can only move up and down through the last column. Once the desired row is selected, press the Trim Knob Control. The current setting (Meaning) displays in blinking inverse video. Now use the Trim Knob Control to cycle through the settings. The values in the Meaning column and the Voltage column change accordingly. This same voltage should be seen at the J102 Connector Pin. Once the desired value/pin is tested and calibrated, press the Trim Knob Control again to end the value test. The current value setting stops blinking.

E.8 NIBP Calibration Screen

This screen is used to perform the NIBP Calibration Check procedure (See section 4.4.1). Select *NIBP Cal* softkey in *Diagnostic Control* screen to access *NIBP Calibration* screen which includes one option field:

- **Mode:** This field allows the user to start/stop the sub-procedures: Calibration Verification, Transducer, Calibration, Overpressure Detection, or System Leakage.

E.9 Setup Screen Defaults

This section lists all the setup screens and shows the field options plus the selected option in the factory (factory default settings) for each field in each setup screen.

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E.9.1 Operator Setup Screens

Operator Setup Screen	Field Name	Field Options	Factory Default Option (set in the factory)	Hospital-Preferred Option
FECG or US/US2	FHR Volume	0-9	5	
	FHR Alarm Limits	200-140, Off 60-140, Off	High Low 160bpm 120bpm	
	Audio Alarms	On, Off	On	
	Volume	1-9	5	
NIBP	Initial Target Pressure	100-250 mmHg in increments of 5 (13.3-33.3 kPa in 0.7 steps)	135 mmHg (18.0 kPa)	
	Mode	Manual, 1, 2, 3, 4, 5, 10, 15, 20, 30, 40, 45, 60, 90, 120 min	Manual	
	NIBP Done Vol	0-9	5	
	Alarm (mmHg mode) Systolic Diastolic MAP MHR/P	High Low 70-240 70-150 50-150 30-120 70-130 100-250 30-120 35-120	High Low 160 mmHg 90 mmHg 50 mmHg 50 mmHg 140 mmHg 50 mmHg 120 bpm 50 bpm	
	Volume	1-9	5	
$MSpO_2$	Response Time (Nellcor 506)	Normal, Fast	Fast	
	Response Time (Nellcor 506)	Fast	Fast	
	Averaging Time (Masimo)	2, 4, 8, 10, 12, 14, 16 seconds	8 seconds	
	Sensitivity (Masimo)	Normal, Maximum	Normal	
	Print Interval	Off, 2, 5, 10, 15, 30, 60 minutes	5 minutes	
	%O2 Trace	On, Off	Off	
	Alarms $MSpO_2$ MHR/P	High Low 85-100 80-99 100-250 35-120	High Low 100 95% 120 50 bpm	
	Volume	1-9	5	

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Operator Setup Screen	Field Name	Field Options		Factory Default Option (set in the factory)		Hospital-Preferred Option
MHR/P	Source	Auto, MECG, $MSpO_2$, NIBP		Auto		
	MHR/P Trace	On, Off		Off		
	Volume	0-9		0		
	Alarms	High 100-250	Low 35-120	High 120	Low 50 bpm	
	Alarm Volume	1-9		5		
	MECG Lead	I, II, III		II		
	Pacer	On, Off		Off		
Normal Operation	(Waveform Display)	FECG, MECG, $MSpO_2$, Off		MECG		
	(MECG Waveform Size)	0.25X, 0.5X, 1X, 2X, 4X, Auto		1X (1 mV/cm)		
Master Alarm Setup	Alarm Limits (mmHg) Systolic Diastolic MAP MHR/P $MSpO_2$	High 70-240 70-130 70-150 100-25 85-100	Low 50-150 30-120 30-120 35-120 80-99	High 160 90 140 120 100	Low 90mmHg 50mmHg 50mmHg 50bpm 95%	
	Alarm (kPa mode) Systolic Diastolic MAP MHR/P	High 9.3-32.0 9.3-17.3 9.3-20.0 100-250	Low 6.7-20.0 4.0-16.0 4.0-16.0 35-120	High 21.3 12.0 18.7 120	Low 12.0kPa 6.7kPa 6.7kPa 50bpm	
	Volume	1-9		5		

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Operator Setup Screen	Field Name	Field Options	Factory Default Option (set in the factory)	Hospital-Preferred Option
General Setup	Play Song	Off, Happy Birthday, Brahms' Lullaby, Rock-a-Bye-Baby, All	Off	
	Song Volume	0-9	5	
	Brightness	0-9 (nine = brightest)	9	
	Paper Speed	1-3 cm/min	United States: 3 cm/min International: 1 cm/min	
	Date	Set to current local date	Set to current local date	
	Time	Set to current local date	Set to current local time. Must manually change to EST/EDT.	
	$MSpO_2$ Print Interval (External Monitor)	Off, 2, 5, 10, 15, 30, 60 min	5 min	
	$FSpO_2$ Print Interval (External Monitor)	Off, 2, 5, 10, 15, 30, 60 min	5 min	
	$FSpO_2$ Trace	Off, On	Off	
Vital Signs History	HX Interval	1, 5, 10, 15, 30, 60, Event	Event	

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E.9.2 Service Mode Screens

Service Setup Screen	Field Name	Field Options	Factory Default Option (set in the factory)	Hospital-Preferred Option
Install Options Screen 1 (Service)	Language	Set according to shipping destination	Set according to shipping destination	
	Line Frequency	50 Hz, 60 Hz	United States: 60 Hz International: 50 Hz	
	Scaling	United States: 30–240 bpm International: 50–210 bpm	United States: 30–240 bpm International: 50–210 bpm	
	Recorder Font Size	Small, Medium, Large	Medium	
	FECG Artifact Elimination	On, Off	Off	
	Paper Chime	Off, Low/out, Out only	Out only	
	Paper Chime Volume	1-9	5	
	HBC (Heartbeat Coincidence Enable)	On, Off	On	
	HR Offset (Applies to US or US2—whichever is FHR2)	Off, On, 10 min	10 min	
	FM (Fetal Movement) Remote Marker	On, Off	On	
	SpO_2 Scale	Auto, 0-100% (Does not change)	0–100%	

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Service Setup Screen	Field Name	Field Options	Factory Default Option (set in the factory)	Hospital-Preferred Option
Install Options Screen 2 (Service)	Fetal Alert/Alarm	Off, Alarms, Alerts	Off	
	Alert Suspend	On, Off	Off	
	Re-Alarm (MECG and SpO_2 only)	120 - 300 seconds in 5-second intervals	120 seconds	
	VS (Vital Signs) Print Interval	Real Time, Chart Style	Real Time	
	Default TOCO Reference	5, 10, 15, 20, or 25 relative units in mmHg mode or 0.7, 1.3, 2.0, 2.7, or in 3.3 kPa mode	10 in mmHg mode or 1.3 in kPa modes	
	Smart BP	On, Off	On	
	NIBP 1-min Interval	On, Off	On	
	NIBP Display	On, 1, 2, 3, 5, 10, 15, 30 min	On	
	Pressure Units	mmHg, kPa	mmHg China: kPa	
	SatSeconds (Nellcor)	Off, 10, 25, 50, 100	10	
	Default Settings	Factory, Hospital	Factory	

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Appendix F: CPU Software Upgrade

This section provides instructions to upgrade the CPU software of the Corometrics™ 250 series monitors.

F.1 Tool Requirement

- Windows® Computer or Laptop
- Software Installation CD-ROM
- Serial Port Flasher Cable (Part number: 1203AAO) for computers/laptops with a serial port OR USB flasher cable (Part number: 2024454-001) for computers/laptops with a USB port

F.2 Upgrade Procedure

1. Before starting the upgrade, check the CPU software version of the monitor in *Diagnostic Control* screen to confirm that the current version of the CPU software is less than the software version of the upgrade CD.

NOTE: The instructions in this procedure are only for upgrading the CPU software to a higher version. The software upgrade program does not support upgrading the CPU software to the same software version.

2. Turn off the monitor.

3. Attach the flasher cable to the serial communications port (COMM1, COMM2, COMM3, or COMM4) of the computer/laptop and to the J110 port on the rear side of the monitor.

4. Turn the computer/laptop on.

CAUTION:
Make sure your laptop is connected to an external power source. Serial ports may not work properly on the laptops running on the internal battery power.

5. Turn the monitor on.

6. Use the Trim Knob Control on the monitor to access the *Communication Setup* screen in the service mode and change the J110 port mode setting to FACTORY and the baud rate to 9600.

7. Access the *Install Options Screen 2* screen and set Default Settings to *Hospital* and then select the Store Current to Hospital to save the settings.

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8. Insert the software installation CD-ROM into the CD-ROM drive of the computer or laptop.

9. Locate flasher.exe file on the CD-ROM and run it.

10. Answer Yes to the first warning dialog box.

11. Look at the “Intended” column of data. Ensure that these options are appropriate for your monitor.

NOTE: All of the options except Fetal Movement and Spectra Alerts can be modified. Fetal Movement and Spectra Alerts are separate, purchased features and cannot be modified by the user.

12. When the Upgrade button becomes available, press Upgrade to start the upgrade (as per the “Intended” column). The monitor will reboot during the upgrade.

CAUTION:
Upon pressing the Upgrade button, DO NOT interrupt the upgrade by unplugging the flasher cable or disconnecting the external power source or terminating the flasher application until the Exit button becomes available.

NOTE: If the upgrade is interrupted for any reasons, the monitor cannot be upgraded anymore and the main board has to be replaced.

NOTE: After the upgrade is complete, the Exit button becomes available. The settings from the monitor will be refreshed in the “Current Monitor” column.

13. Close the flasher program and unplug the flasher cable.

14. Perform a functional checkout procedure on the monitor as instructed in the product service manual. If the functional checkout fails, repeat steps 1 to 12 to perform the upgrade procedure again. Call service if the functional checkout procedure continues to fail.

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Appendix G: Corometrics™ 325 Simulator Setup and Use

GE Healthcare has discontinued the sales of The Corometrics™ 325 fetal simulator and recommends an alternate fetal simulator, i.e. PS320 simulator manufactured by Fluke® Biomedical, as a substitute for Corometrics™ 325 fetal simulator to perform the tests and troubleshooting on the Corometrics™ 250cx Series monitors.

For the customers who still use the Corometrics™ 325 fetal simulator, this Appendix covers the simulator setup information and provides the relevant functional checks instructions based on the use of Corometrics™ 325 fetal simulator.

NOTE: Corometrics™ 305 simulators do not work with the Corometrics™ 250cx Series monitors. Use a Corometrics™ 325 simulator and a Y adapter cable (Part number: 1442AAO) for the functional checks.

G.1 Simulator Setup

Make sure both the Corometrics™ 250cx Series monitor and the Corometrics™ 325 fetal simulator are turned off. Confirm the Power Switches are in the off position.

1. Connect the simulator power cord to the power connector on the rear panel of the simulator and then plug the power cord into a properly-grounded power outlet.

2. Connect the simulator interconnect cable's 50-pin end to the simulator's Fetal Monitor connector.

3. Insert the green plug of the FECG/MECG adapter cable (Part number: 1442AAO) into the FECG/MECG connector of the monitor.

4. Connect the sub-cables of the other end of the simulator interconnect cable into the color-coded connectors on the monitor/adapter: ECG, US, and UA.

5. Turn on the fetal simulator. Verify that the green Power Indicator illuminates.

6. Turn on the Corometrics™ 250cx Series monitor

G.2 Alarms Check

1. Connect the FECG/MECG adapter cable to the FECG/MECG input connector on the monitor unit.

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2. Connect the 325 simulator's ECG cable to the MECG input of the adapter.
3. Use the Trim Knob Control to access the *MHR/P* Setup screen.
4. Set the MHR/P source to *MECG*.
5. Set the MHR/P high alarm limit value to 120 bpm.
6. Set the MHR/P low alarm limit value to 60 bpm.
7. Set the alarm volume to a level you can easily hear.
8. Exit the *MHR/P Setup* screen.
9. Access the *Master Alarm Setup* screen.
10. Access *Install Options Screen 2*.
11. Select *Store Current to Hospital*. Exit the service mode by selecting *Restart* at the bottom of the screen.
12. Set the switches on the 325 simulator according to Table G-1.

Table G-1: 325 Simulator Settings for Alarms Check

Section	Switch Name	Setting
FECG/MECG	Main	Rate
	Rate	Manual
	Mode	MECG
	QRS Amplitude	500 μV
	QRS Polarity	+
GENERAL	Pattern Memory	Off

13. Using the simulator's Manual Adjustment knob, input an MECG signal of 119 bpm as indicated on the monitor. Verify that there is no alarm tone sounding from the rear panel speaker.
14. Using the simulator's Manual Adjustment knob, increase the MECG rate to 120 bpm. Again, verify that there is no alarm tone sounding from the rear panel speaker.
15. Using the simulator's Manual Adjustment knob, increase the MECG rate to 121 bpm. Verify the following on the monitor:
    - The following alarm tone is emitted from the rear panel speaker: alternating high/low tones until the alarm condition is removed (following steps.)
    - The MECG value flashes.
16. Depress the front panel Alarm Silence button and verify the following:

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- The alarm tone is silenced.
- The *ALARM SILENCE X:XX* message box appears on the screen and a countdown is started.

17. Wait the user-specified re-alarm time and verify that the alarm tone is once again emitted from the rear panel speaker.

18. Use the simulator's Manual Adjustment knob to decrease the MECG rate to 120 bpm. Verify the following on the monitor:

    - The alarm tone is silenced.
    - The MECG value no longer flashes.
    - After 10 seconds, the two above conditions are still true.

19. Using the simulator's Manual Adjustment knob, input an MECG signal of 61 bpm. Verify that there is no alarm tone sounding from the rear panel speaker.

20. Using the simulator's Manual Adjustment knob, decrease the MECG rate to 60 bpm. Again, verify that there is no alarm tone sounding from the rear panel speaker.

21. Using the simulator's Manual Adjustment knob, decrease the MECG rate to 59 bpm. Verify the following on the monitor:

    - The alarm tone is emitted from the rear panel speaker.
    - The MECG value flashes.

22. Depress the front panel Alarm Silence button and verify the following:

    - The alarm tone is silenced.
    - The MECG value continues flashing.
    - The message *ALARM SILENCE X:XX* appears on the screen and a countdown is started.

23. Wait the user-specified re-alarm time and verify that the alarm tone is once again emitted from the rear panel speaker.

24. Use the simulator's Manual Adjustment knob to decrease the MECG signal to 60 bpm. Verify the following on the monitor:

    - The alarm tone is silenced.
    - The MECG value no longer flashes.
    - After 10 seconds, the two above conditions are still true.

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G.3 MECG Input Check

1. Connect the simulator's ECG cable to the MECG connector on the monitor adapter cable (Part number: 1442AAO).

2. Connect the simulator's UA cable to the UA connector on the monitor.

3. Set the switches on the 325 simulator according to Table G-2.

Table G-2: 325 Simulator Settings for MECG Input Check

Section	Switch Name	Setting
FECG/MECG	Rate/CMR	Rate
	Rate	Manual
	Mode	MECG
	QRS Amplitude	15 μV
	QRS Polarity	+
GENERAL	Pattern Memory	Off
UA	Main	CMR
	Mode	TOCO

4. If not already on, depress the *Record* button.

5. Turn the simulator's Manual Adjustment knob counterclockwise and verify the following on the monitor display until the monitor reads a value of 30 bpm:

   - The MHR/P mode is MECG.
   - The MHR heartbeat indicator (♥) flashes at a rate of 30 times per minute.
   - The UA mode is TOCO.

6. Access the *Install Options Screen 2* and note the *Default TOCO* Reference value. Exit the service mode by selecting Restart at the bottom of the screen.

7. After the monitor restarts, press the front panel *UA Reference* button.

8. Verify the following on the monitor:

   - The UA value is referenced to the default value.
   - The recorder prints a continuous line at the default value on the bottom grid of the strip chart paper.
   - The recorder prints the message UA REF on the strip chart paper.

9. Turn the simulator's Manual Adjustment knob until the monitor displays an MECG signal of approximately 60 bpm. Verify the following on the monitor:

   - The MHR value is 60 bpm.
   - The MHR heartbeat indicator (♥) flashes at a rate of 60 times per minute (1 per second).

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- The ECG "beep" volume is generated from the rear panel speaker. The volume can be adjusted on the *MHR/P Setup* screen.
- Set *HR/PR* Trace to *On* in the *MHR/P Setup* screen The recorder should print a continuous line at 60 bpm on the top grid of the strip chart paper.

G.4 FECG Input Check

1. Connect the simulator's ECG cable to the FECG connector on the Y adapter cable.

2. Connect the simulator's UA cable to the UA connector on the monitor.

3. Set the switches on the 325 simulator according to Table G-3.

Table G-3: 325 Simulator Settings for FECG Input Check

Section	Switch Name	Setting
FECG/MECG	Rate/CMR	Rate
	Rate	Manual
	Mode	MECG
	QRS Amplitude	15 μV
	QRS Polarity	+
GENERAL	Pattern Memory	Off
UA	Main	CMR
	Mode	TOCO

4. If not already on, depress the *Record* button.

5. Turn the simulator's Manual Adjustment knob counterclockwise and verify the following on the monitor display:

   - The FECG value is 30 bpm.
   - The FECG mode is FECG.
   - The FECG heartbeat indicator (♥) flashes at a rate of 30 times per minute.
   - The UA mode is TOCO.

6. Depress and hold the *UA Reference* button and release when the UA value shows 10 relative units in mmHg mode or 1.3 kPa in kPa mode. Verify the following on the monitor:

   - The UA value is referenced to 10 mmHg (1.3 kPa) on the display.
   - The recorder prints a continuous line at 10 mmHg (1.3 kPa) on the bottom grid of the strip chart paper.
   - The recorder prints the messages UA REF on the strip chart paper.

7. Turn the simulator's Manual Adjustment knob to input an FECG signal of approximately 120 bpm. Verify the following on the monitor:

   - The FECG value is 120 bpm.
   - FECG heartbeat indicator (♥) flashes at a rate of 120 times per minute.

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- The ECG "beep" volume of the rear panel speaker can be increased or decreased using the left pair of Volume buttons (Set the volume to the desired level).
- The recorder prints a continuous line at 120 bpm on the *HR grid* of the strip chart paper.

8. Repeat Step 7 for each of the following rates: 30, 60, 210, and 240 bpm.

9. Change the simulator's QRS Polarity switch from + to –. Verify that the monitor does not skip any beats.

10. Set the simulator's ECG Rate switch to the RAMP setting. Verify that the FECG value counts between approximately 30 and 240 bpm and that the recorder prints a ramp between the same values.

11. Access *Install Options Screen 2* and set ECG Artifact Elimination to *Off*. Then exit the service mode by selecting Restart at the bottom of the screen.

12. Set the simulator's ECG Rate switch to the Δ15 position. Verify the following on the monitor:

    - The FECG value alternates by 15 bpm.
    - The FHR1 heartbeat indicator (♥) flashes for each input signal.
    - The ECG "beep" is generated from the rear panel speaker.
    - The recorder prints an oscillation of 15 bpm between 110 and 125 bpm on the top grid of the strip chart paper.

13. Repeat Step 12 for rates values of Δ22 and Δ27. The results should be the same except that the FHR1 value alternates by either 22 or 27 bpm and the recorder prints an oscillation of 22 or 27 bpm. The top value is always at approximately 125 bpm.

14. Access *Install Options Screen 2* and set the *FECG Artifact Elimination* to *On*.

15. Set the simulator's ECG Rate switch to the Δ15 position. Verify the following on the monitor:

    - The FHR1 value alternates by 15 bpm.
    - The FHR1 heartbeat indicator (♥) flashes for each input signal.
    - The ECG "beep" is generated from the rear panel speaker.
    - The recorder prints an oscillation of 15 bpm between 110 and 125 bpm on the top grid of the strip chart paper.

16. Repeat Step 15 for the rate value of Δ22. The result should be the same as Step 15 except that the FHR1 value alternates between 22 bpm and the recorder prints an oscillation of 22 bpm between the 103 and 125 bpm on the strip chart recorder paper.

17. Set the simulator's ECG Rate switch to the Δ27 position. Verify the following on the monitor:

    - The FHR1 value oscillates by 27 bpm.
    - The FHR1 heartbeat indicator (♥) flashes for each input signal.
    - The ECG "beep" is generated from the rear panel speaker.
    - The recorder does not print any oscillation.

18. Access *Install Options Screen 2* and set the *FECG Artifact Elimination* back to *Off*.

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19. Set the simulator's ECG Rate switch to the MANUAL position and the Manual Adjustment knob to the counterclockwise position. Disconnect the ECG simulator cable from the Y adapter cable. Verify the following on the monitor:

    - The FHR1 value and mode are both blank.
    - The recorder stops printing heart rate data on the strip chart paper.
    - The recorder prints the message *CARDIO INOP* on the center margin of the strip chart paper after approximately 30 seconds.
    - Set the simulator's ECG Mode switch to the *Off* position.

G.5 Ultrasound Input Check

1. Connect the simulator's US cable to the US connector on the monitor.

2. Set the switches on the Model 325 Input Simulator according to Table G-4.

Table G-4: 325 Simulator Settings for Ultrasound Input Check

Section	Switch Name	Setting
US/FMD	Mode	US
	Signal Level	MED
	Rate	Manual
GENERAL	Pattern Memory	Off
UA	Main	CMR
	Mode	TOCO

3. If not already on, depress the *Record* button.

4. Turn the simulator's Manual Adjustment knob to input an ultrasound signal of approximately 120 bpm. Verify the following on the monitor:

    - The FHR1 value is 120 bpm.
    - The FHR1 mode is US.
    - The FHR1 heartbeat indicator (♥) flashes at a rate of 120 times per minute.
    - Ultrasound audio volume from the rear panel speaker can be increased or decreased using the upper-left pair of Volume buttons (Set the volume to the desired level).
    - The recorder prints a continuous line at 120 bpm on the top grid of the strip chart paper.
    - The recorder prints the message *US* on the center margin of the strip chart paper after approximately 20 seconds.

5. Use the simulator's Manual Adjustment knob to increase the heart rate value by less than 13 bpm from the 120 bpm baseline. Verify the following on the monitor:

    - The FHR1 value immediately reflects this new input rate.
    - The strip chart recorder immediately reflects this new input rate.

6. Use the simulator's Manual Adjustment knob to decrease the heart rate value by more than 13 bpm from the 120 bpm baseline. Verify the following on the monitor:

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- The FHR1 value immediately reflects this new input rate.
- The strip chart recorder prints at the last input rate for an additional 3 seconds before blanking the heart rate data and printing a continuous line at the new input rate.

7. Set the simulator's US Rate switch to the RAMP position. Verify that the FHR1 value counts between approximately 50 and 210 bpm and that the recorder prints a ramp between the same values.

8. Place the simulator's US Rate switch in each of the individual rate settings (50, 60, 120, and 210 bpm). Verify the following on the monitor:

   - The FHR1 value reflects the simulator setting ± 1 bpm.
   - The FHR1 heartbeat indicator (♥) flashes at the simulator setting.
   - Ultrasound audio is generated from the rear panel speaker.
   - The recorder prints a continuous line at the respective value ± 3 bpm on the top grid of the strip chart paper.

9. Repeat Step 4 through Step 8 using the second ultrasound channel. (The mode will show US2.)

10. Place the simulator's *US Mode* switch in the *Off* position. Verify the following on the monitor:

    - The FHR1 value and mode are both blank.
    - The recorder stops printing the fetal heart rate trace.
    - The recorder prints the message *CARDIO INOP* on the center margin of the strip chart paper after approximately 20 seconds.

G.6 Uterine Activity Check

1. Set the switches on the 325 simulator according to Table G-5,

Table G-5: 325 Simulator Settings for Uterine Activity Check

Section	Switch Name	Setting
US/FMD	Mode	TOCO
	Level	0 mmHg
	Main	Level
	Pattern Memory	Off

2. Connect the simulator's UA cable to the UA connector on the monitor.

3. Access the *Install Options Screen 2* and select *Pressure units*: *mmHg* mode.

4. Access the *Install Options Screen 2* and note the *Default TOCO Reference* value. (The monitor is shipped from the factory with this value set at 10 mmHg (1.3 kPa). However, your unit may have been custom configured.) Exit the service mode by selecting Restart at the bottom of the screen.

5. If not already on, depress the *Record* button.

6. Briefly press the *UA Reference* button. Verify the following on the monitor:

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- The UA value is the default setting.
- The UA mode is TOCO.
- The recorder prints a continuous line at the default value on the uterine activity channel of the strip chart paper.
- The recorder prints the messages *UA REF* on the strip chart paper.

7. Press and hold the *UA Reference* button on the monitor to cycle through the available selections for *UA reference: 5, 10, 15, 20,* or *25* relative units in mmHg mode. Test each of these reference settings. Verify that the UA value is displayed accordingly and that the recorder prints a continuous line at the corresponding value on the uterine activity channel of the strip chart paper.

8. Place the simulator's UA Level switch at each of the level settings: 0, 10, 50, and 100 relative units. Verify that the UA value is displayed accordingly and that the recorder prints a continuous line at the corresponding value on the heart rate channel of the strip chart paper.

9. Place the simulator's UA Mode switch in the IUP position and the UA Level switch to 0 mmHg/kPa. Depress the *UA Reference* button and verify that the monitor and recorder reference to 0 mmHg/kPa. Verify the following on the monitor:

   - The UA value is 0 mmHg.
   - The UA mode is IUP.
   - The recorder prints a continuous line at 0 mmHg on the uterine activity channel of the strip chart paper.
   - The recorder prints the messages *UA REF* on the strip chart paper.

10. Place the simulator's UA Level switch at each of the level settings: 0, 10, 50, and 100 mmHg. Verify that the UA value is displayed accordingly and that the recorder prints a continuous line at the corresponding value on the uterine activity channel of the strip chart paper.

11. Place the simulator's UA Level switch to the RAMP position. Verify that the UA value measures between approximately 0 and 100 mmHg and that the recorder prints a ramp between the same values.

12. Disconnect the 325 simulator's UA cable from the UA input connector the front panel of the monitor. Verify the following on the monitor:

    - The UA value and IUP are both blank.
    - The recorder stops printing the uterine activity trace.
    - The recorder prints the message UA INOP on the center margin of the strip chart paper after approximately 20 seconds.

G.7 Pattern Memory Check

The pattern memory of the simulator can be used to test any of the following mode combinations of the monitor: FECG/TOCO, FECG/IUP, MECG/TOCO, MECG/IUP, US/TOCO, US/IUP, US/FMD/TOCO, US/FMD/IUP, US2/TOCO, US2/IUP, FECG/US/TOCO, FECG/US/IUP, FECG/US2/TOCO, FECG/US2/IUP, US/TOCO/MECG, US/IUP/MECG, US2/TOCO/MECG, US2/IUP/MECG.

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NOTE: US/US2 cannot be tested simultaneously unless two 325 simulators or two ultrasound transducers are used. Do not perform the dual ultrasound test using one 325 simulator and one ultrasound transducer or a conflict between enable lines will occur.

NOTE: FECG/MECG cannot be tested simultaneously unless two 325 simulators are used.

NOTE: Dual heart rate check can be done using the pattern memory check.

To check any of the mode combinations listed above:

1. Connect the appropriate simulator sub-cables to the corresponding connectors on the monitor.
2. Enable the modes on the simulator.
3. Set the simulator's Pattern Memory switch to the *ON* position.
4. If not already on, depress the *Record* button.
5. Verify the following on the monitor:
   - Each heart rate area (FHR1, FHR2, and/or MECG) responds accordingly for value, mode, and heartbeat indicator.
   - The UA area responds accordingly for value and mode.
   - The recorder responds appropriately in both trending and message information.

G.8 Dual Heart Rate Check (Non-Pattern, FECG/US Modes)

1. Connect the FECG/MECG adapter cable to the FECG/MECG connector on the monitor unit.
2. Connect the 325 simulator's ECG cable to the FECG input on the Y adapter cable.
3. Connect the simulator's US cable to the US input connector.
4. Set the switches on the 325 simulator according to Table G-6.

Table G-6: 325 Simulator Settings for Dual Heart Rate (Non-Pattern) Check

Section	Switch Name	Setting
FECG/MECG	Rate/CMR	Rate
	Rate	120 bpm
	Mode	FECG
	QRS Amplitude	50 μV
	QRS Polarity	+

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Section	Switch Name	Setting
Ultrasound/FMD	Mode	US
	Level	MED
	Rate	RAMP
GENERAL	Pattern Memory	Off

5. If not already on, depress the *Record* button.

6. Verify the following on the monitor:

   - The FHR1 value reads 120 bpm ± 1 bpm.
   - The FHR1 mode reads FECG.
   - The FHR1 heartbeat indicator (♥) flashes at a rate of 120 times per minute.
   - The FHR2 value varies between approximately 50 and 210 bpm.
   - The FHR2 mode reads US.
   - The FHR2 heartbeat indicator (♥) flashes at a rate consistent with the value.
   - The recorder prints the messages *FECG* and *US* on the center margin of the strip chart paper.
   - The recorder prints a continuous plain black line ( ) on the 120 bpm mark on the heart rate channel of the strip chart paper.
   - The recorder prints a bold black ramp trace ( ) between 50 and 210 bpm on the heart rate channel of the strip chart paper.

G.9 Dual Heart Rate Check (Non-Pattern, Dual US Modes)

NOTE: This check cannot be done unless two 325 simulators or two ultrasound transducers are used. Do not perform this check using one 325 simulator and one ultrasound transducer. The following instructions detail the procedure of using two ultrasound transducers.

1. If not already on, depress the *Record* button.

2. Plug one ultrasound transducer into the US input connector and the other into the US2 connector. Verify the following on the monitor:

   - The FHR1 mode shows US.
   - The FHR2 mode shows US2.
   - The FHR1 value shows three steady dashes "– – –."
   - The FHR2 value shows three steady dashes "– – –."
   - The recorder prints the messages *US* and *US2* on the center margin of the strip chart paper.

3. Use your finger to rub the face of the ultrasound transducer connected to the US input connector and maintain a steady rate and verify the following on the monitor:

   - The FHR1 value responds to the rubbing.
   - The FHR1 heartbeat indicator (♥) responds to the input.
   - The recorder prints the heart rate tracing corresponding to the rate and the trace is plain black ( ).

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4. Use your finger to rub the face of the ultrasound transducer connected to the US2 input connector and maintain a steady rate and verify the following on the monitor:
   - The FHR2 value responds to the rubbing.
   - The FHR2 heartbeat indicator (♥) responds to the input.
   - The recorder prints the heart rate tracing corresponding to the rate and the trace is bold black ( ).

G.10 Fetal Movement Detection Check

This section provides instructions to check the integrity of the fetal movement detection circuitry and the heart rate channel of the recorder.

1. Connect the simulator's US cable to the US connector on the monitor. Select the FHR2 mode field. Make sure FM Detect is On.

2. Set the switches on the 325 simulator according to Table G-7.

Table G-7: 325 Simulator Settings for Fetal Movement Detection Check

Section	Switch Name	Setting
US/FMD	Mode	US/FMD
	Signal Level	MED
	Rate	Manual
UA	Main	CMR
	Mode	TOCO

3. If not already on, depress the *Record* button.

4. Turn the simulator's Manual Adjustment knob to input an ultrasound signal of approximately 120 bpm. Verify the following on the monitor:
   - The FHR1 value is 120 bpm.
   - The FHR1 mode is US.
   - The FMD indication displays in between the FHR1 and FHR2 mode title locations if alerts are not enabled.
   - The FHR1 heartbeat indicator (♥) flashes at a rate of 120 times per minute.
   - Ultrasound audio volume from the rear panel speaker can be increased or decreased using the upper-left pair of Volume buttons (Set the volume to the desired level).
   - The recorder prints a continuous line at 120 bpm on the top grid of the strip chart paper.
   - Fetal movement markers (▬) are shown on for 1 second, then off for 8 seconds, then on for 1 second, etc.
   - The recorder prints the messages *US* and *FMD* (▬) on the center margin of the strip chart paper after approximately 20 seconds.

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